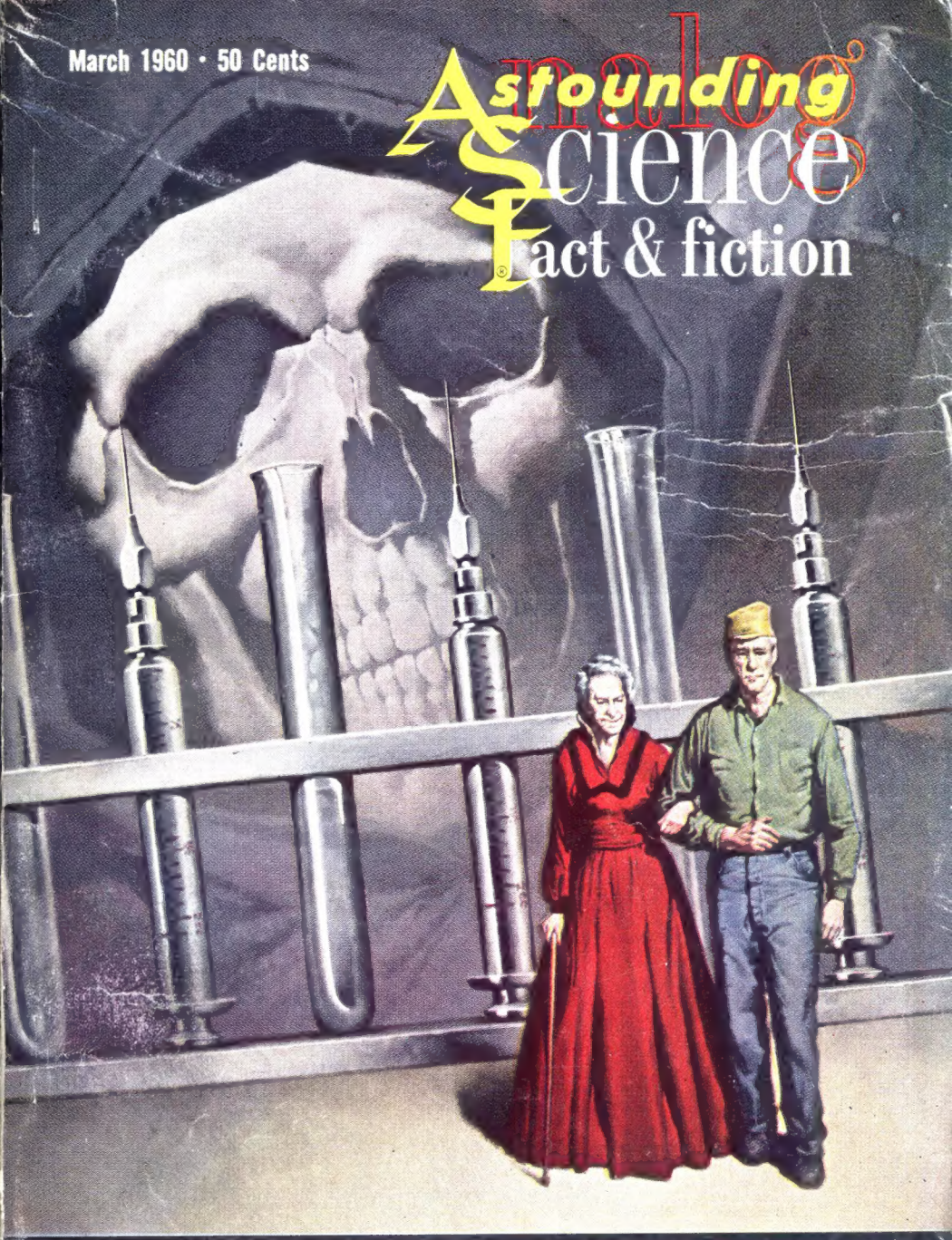
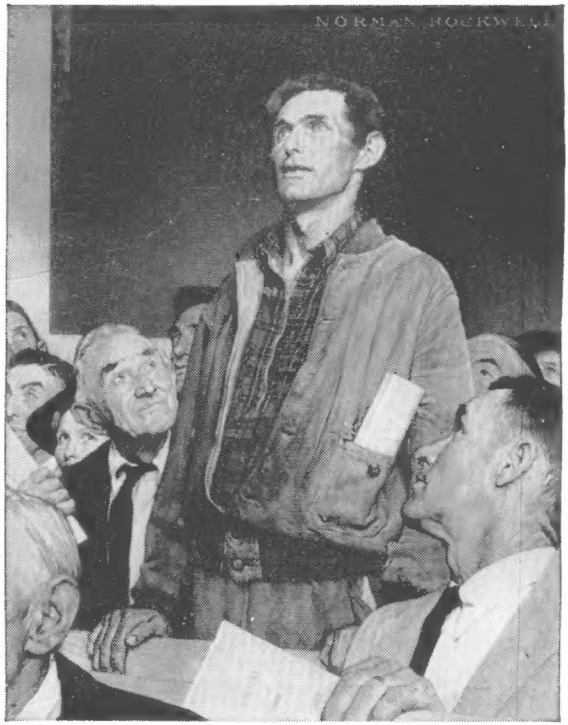
March 1960 · 50 Cents

Astounding Science Fact & fiction



IMMORTALITY FOR SOME BY J. T. McINTOSH

HELP US KEEP THE THINGS WORTH KEEPING



Speech is free in America. But it's not free for the *keeping!* Protecting our American heritages costs money.

Money for strength to keep the peace. Money for science and education to help make peace lasting. And money saved by individuals.

Your Savings Bonds, as a direct investment in your country, make you a Partner in strengthening America's Peace Power.

HELP STRENGTHEN AMERICA'S PEACE POWER

BUY U. S. SAVINGS BONDS

The U.S. Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, The Advertising Council and this magazine.

Make over 200 Small Computing and Reasoning Machines with . . . BRAINIAC®

NEW 1960 ELECTRIC BRAIN CONSTRUCTION KIT

WITH OUR BRAINIAC KIT K18, you can build over 200 small electric brain machines and toys which "think," compute, reason, and display intelligent behavior. Each one works on a single flashlight battery . . . is FUN to make, FUN to use and play with, and TEACHES you something new about electrical computing and reasoning circuits. All connections with nuts and bolts—no soldering required. Originated and produced by Berkeley Enterprises. Brainiac is the result of 10 years' design and development work with miniature mechanical brains including: Geniac (see "Geniacs: Small Electric Brain Machines and How to Make Them" by Edmund C. Berkeley), Tyniac, Relay Moe (automatic relay machine playing tit-tat-toe—pictured in Life Magazine, March 19, 1956), Simon (miniature automatic digital computer with 129 relays—see "Simple Simon" by E. C. Berkeley in Scientific American, November 1950), Squee (electronic robot squirrel — see "Light Sensitive Electronic Beast" by E. C. Berkeley in Radio Electronics, December, 1951), etc.

PROGRAMMING *YOUR* OWN PROBLEMS FOR THE BRAINIAC!

The Brainiac is the smallest and lowest-cost semi-automatic, general-purpose digital computer existing. Many problems in ALL fields of knowledge and business can be programmed for the Brainiac—to the extent that a number of versatile mulliple switches can express the problem. We shall be glad to program YOUR OWN problems. Write us—no charge for simple problems, modest charge for complicated ones.

WHAT CAN YOU MAKE WITH BRAINIAC KIT K18? Over 200 machines including—LOGIC MACHINES: Syllogism Prover, Intelligence Test, Boolean Algebra Circuits, Douglas MacDonald's Will Analyzer, Diagnosing Motor Car Trouble, etc. GAME-PLAYING MACHINES: Tit-Tat-Toe, Nim, Wheeled Bandit, Black Match, Sundorra 21, etc. COMPUTERS: That add, subtract, multiply or divide using decimal or binary numbers. Forty-Year Calendar, Prime Number Indicator, Money-Changing Machine, etc. CRYPTOGRAPHIC MACHINES: Coders, Decoders, Lock with 15,000,000 Combinations, etc. PUZZLE-SOLVING MACHINES: The Missionaries and the Cannibals, Age-Guessing Machine, Submarine Rescue Chamber, Fox-Hen-Corn & Hired Man, Uranium Space Ship and the Space Pirates, The Three Monkeys Who Spurned Evil, General Alarm at the Fortress of Dreadeerie, etc. QUIZ MACHINES: How to Tell an Aardvark from an Armadillo, The Waxing and the Waning Moon, Polar Air Routes, history, geography, trigonometry, grammar, statistics, calculus, etc.

WHAT COMES WITH YOUR BRAINIAC KIT . . . Complete Plans, Instructions, Explanations and Hardware:

- Every part needed to build Brainiacs, Geniacs, Tyniacs—over 600 pieces including control panel, multiple switch discs, jumpers, 116 patented improved wipers, bulbs, sockets, washers, wire, battery and special tools.
- Full descriptions and specifications for 201 computing, reasoning, arithmetical, logical, puzzle-solving and game-playing machines and experiments.
- Over 170 circuit diagrams including 46 exact wiring templates.
- Textbook "Brainiacs—201 Small Electric Brain Machines and How to Make Them" by Edmund C. Berkeley, 1959, 256 pages, *including as chapters* "Introduction to Boolean Algebra for Circuits and Switching" *and* "How to Go from Brainiacs and Geniacs to Automatic Computers."

only $18.95 . . .

MORE VALUE • MORE FEATURES

BRAINIAC KIT (1960 Model) K18..the kit with limitless possibilities—backed by an organization of 12 years' standing in the computer field. $18.95
(For shipment west of Mississippi, add 80¢; outside U. S., add $1.80)

7-Day Full Refund Guarantee If Not Satisfactory

WHO IS EDMUND C. BERKELEY? Author of *"Giant Brains or Machines That Think,"* Wiley, 1949, 270 pp. (15,000 copies sold); author of *"Computers: Their Operation and Applications,"* Reinhold, 1956, 366 pp; author of *"Symbolic Logic and Intelligent Machines,"* Reinhold 1959, 203 pp.; Editor and Publisher of the magazine, *"Computers and Automation;"* Maker and Developer of small robots; Fellow of the Society of Actuaries; Secretary (1947-53) of the Association for Computing Machinery; Designer of all the Tyniacs and Brainiacs, more than half of the 33 Geniacs (1955); Designer of the patented Multiple Switch Disc and other features in the 1955 Geniac kit.

MAIL THIS COUPON

BERKELEY ENTERPRISES, Inc.
815 Washington St., R 210, Newtonville 60, Mass.

Please send me Brainiac Kit K18. (Returnable in 7 days for full refund if not satisfactory—if in good condition.) I enclose $_____ in full payment.

My Name and Address are attached.

Astounding Science Fact & fiction

Novelette

Immortality for Some, *J. T. McIntosh* . . . 8

Short Stories

In Case of Fire, *Randall Garrett* 42

Shotgun Wedding, *Christopher Anvil* . . . 50

The Barrier Moment, *Winston P. Sanders* . 122

Serial

Deathworld, *Harry Harrison* 62
(Conclusion)

Science Fact

Mars: A Summing Up, *R. S. Richardson* . . 83

Microdesign for Living, *Isaac Asimov* . . . 104

Readers' Departments

The Editor's Page 6

The Analytical Laboratory 41

In Times to Come 128

The Reference Library, *P. Schuyler Miller* 155

Brass Tacks 165

JOHN W. CAMPBELL, JR.
Editor

KAY TARRANT
Assistant Editor

Advertising Manager: WALTER J. McBRIDE

H. A. Staab, *Art Director*

COVER BY VAN DONGEN

Illustrations by Martinez, Summers and van Dongen

VOL. LXV

NO. 1

MARCH 1960

The editorial contents have not been published before, are protected by copyright and cannot be reprinted without publisher's permission. All stories in this magazine are fiction. No actual persons are designated by names or character. Any similarity is coincidental.

Astounding Science Fact & Fiction published monthly by Street & Smith Publications, Incorporated, at 575 Madison Avenue, New York 22, New York. Arthur Z. Gray, President; Robert E. Park, Vice-President and Advertising Director; Thomas H. Kulser, Secretary-Treasurer.

© 1960 by Street & Smith Publications, Inc. All rights reserved under International and Pan American Copyright Convention.

Second-class postage paid at New York, New York. Subscription $5.00 for one year, $9.00 for two years, and $12.00 for three years in the United States, possessions and Canada; $6.25 for one year, $11.00 for two years, $14.50 for three years in Pan American Union, Philippine Islands and Spain. Elsewhere $6.50 for one year, $11.50 for two years, and $15.00 for three years. When possible allow four weeks for change of address. Give old address and new address when notifying us. We cannot accept responsibility for unsolicited manuscripts or art work. Any material submitted must include return postage. All subscriptions should be addressed to Subscription Department, Street & Smith Publications, Incorporated, 304 East 45th Street, New York 17, New York.

Send notice of undelivered copies on Form 3579 to: Astounding Science Fact & Fiction, McCall Street, Dayton 1, Ohio.

Printed in the U. S. A.

NEXT ISSUE ON SALE MARCH 15, 1960

$5.00 per Year in U. S. A.
50 Cents per copy

PICK-A-BOOK DOES IT AGAIN

We've added 40 new titles to our already impressive list of over a hundred science fiction books. Now you have the opportunity of a lifetime to build your own library of the best science fiction available. No "reprint editions" . . . these are the original publishers' editions.

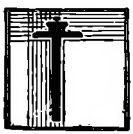
Just choose from some of the titles listed here.
Each book is $1.50 • 3 books for $4.00
6 for $7.50 and 10 for $12.00

Starways	*Poul Anderson*
Virgin Planet	*Poul Anderson*
Tower of Zanid	*L. S. de Camp*
Wasp	*Eric Frank Russell*
Fire in the Heavens	*George O. Smith*
Troubled Star	*George O. Smith*
Big Planet	*Jack Vance*
Languages of Pao	*Jack Vance*
Solomons Stone	*L. S. de Camp*
Out of this World	*Murray Leinster*
Islands of Space	*John W. Campbell*
Operation: Outer Space	*Murray Leinster*
Galactic Patrol	*E. E. Smith, Ph.D.*
Second Stage Lensman	*E. E. Smith, Ph.D.*
Children of the Lens	*E. E. Smith, Ph.D.*
The Cometeers	*Jack Williamson*
Masters of Time	*A. E. Van Vogt*
Assignment in Eternity	*R. E. Heinlein*
Red Peri	*Stanley Weinbaum*
Sinister Barries	*Eric Frank Russell*
Dreadful Sanctuary	*E. F. Russell*
Legion of Time	*Jack Williamson*
Foundation & Empire	*Isaac Asimov*
Second Foundation	*Isaac Asimov*
Interplanetary Hunter	*Arthur Barnes*
Sands of Mars	*Arthur C. Clarke*
Colonial Survey	*Murray Leinster*
Plague Ship	*Andrew North*
Shrouded Planet	*Robert Randall*
Dawning Light	*Robert Randall*
Against the Fall of Night	*Arthur C. Clarke*
Prelude to Space	*Arthur C. Clarke*
All About the Future	*Martin Greenberg*
Coming Attractions	*Martin Greenberg*
SF '56 Year's Greatest	*Judith Merril*
SF '57 Year's Greatest	*Judith Merril*
SF '58 Year's Greatest	*Judith Merril*
SF '59 Year's Greatest	*Judith Merril*
Highways in Hiding	*George O. Smith*
Path of Unreason	*George O. Smith*
Coming of Conan	*Robert E. Howard*
Conan the Barbarian	*Robert E. Howard*
Sword of Conan	*Robert E. Howard*
King Conan	*Robert E. Howard*
Conan the Conqueror	*Robert E. Howard*
Tales of Conan	*Howard & de Camp*
Return of Conan	*Nyberg & de Camp*
Two Sought Adventure	*Fritz Leiber*
Agent of Vega	*James H. Schmitz*
The Vortex Blaster	*E. E. Smith, Ph.D.*
Invaders from the Infinite	*John Campbell*
Bird of Time	*Wallace West*

Write for our free catalog listing dozens of other titles.

PICK-A-BOOK • P. O. Box 63 • Hicksville, New York

THE ONE-EYED GUIDE



THE ancient adage that "the truth will out!" seems to have been accepted into general belief along about the time of Trial by Ordeal, examination for Witch Marks, and similar serious matters.

Truth doesn't "out"; it can be extruded into view only by the application of great pressure, skillfully applied—and frequently the individual who does force the truth into sight is wise to disappear himself. Copernicus, for instance; he arranged to have his theories of the heliocentric system published posthumously, when he was safely out of harm's way. (He did relent, and publish it shortly before his death—but only shortly!) His wisdom was shown by the reception Galileo's subsequent efforts received.

Galileo forced the truth into sight; he did it by making himself obnoxiously noisy, and by the use of some magnificent feats of pure showmanship. The bald-faced promotion-gimmick of dropping weights from the top of the famous Tower of Pisa, for instance. As a scientific experiment, it was very bad experiment-design; velocities reached such high values that both his light and heavy objects became unobservable, it was an experiment very laborious to repeat, and could not be repeated by anyone not having a handy leaning tower to use. But as a promotion gag . . . ! We're still talking about it!

Gregor Mendel discovered the laws of genetics, and duly—and dully—published his findings. If Darwin had done the same with his theory of evolution, it would, like

Mendel's work, have died in the dark unnoticed. Darwin was a writer; he not only stated his findings, he made them interesting, exciting, adventurous.

It took another man, decades after Mendel's work was completely and fruitlessly lost, to rediscover the basic laws of genetics—and do what Mendel failed to do; force the truth into sight after he'd discovered it.

It has been the ideal, the fond hope, of theoreticians since men first invented theories, that the Truth was its own self-starting, self-propelling, self-communicating sufficiency. The theoretician wants it that way, so that once he has discovered the Truth, it will be all that he need do. The nontheoretician likes the proposition that the Truth is automatically self-convincing too—because in that case, anything that he isn't convinced of isn't true. It's similar to the argument that "All *real* geniuses are recognized, even if not right away. You can't name a single *real* genius that didn't get the credit due him eventually, can you!" No, you certainly can't . . . not when "real genius" is defined (as it is in that statement's implication) as being an *acknowledged* genius. "Every acknowledged genius has been acknowledged sooner or later," is the exact meaning of the statement.

If that be accepted, then the fact that Junius Q. Thither isn't an acknowledged genius proves Junius is a crackpot, which is an immense relief because that means I don't have to learn his new and highly disturbing idea.

The result is that both the theoretician-with-an-idea and the citizen-who-has-enough-ideas-already agree, for quite opposite reasons, that the Truth is self-convincing—that it need only be exposed to be accepted.

Some of the problems concerned in this area of trying to make the self-evident Truth become obvious appear if you study the Naval Research Advisory Committee's report on "Basic Research in the Navy."

Physically, the report is a very handsome job of typography, beautifully presented, with two-color printing on every page, wide, clean margins, and a fine, heavy grade of pure-white book paper, bound in a plastic binder. There are many large four-color fold-out charts and flow-sheets. Clearly, the job has been done thoroughly, carefully, and expensively.

The report itself was prepared by Arthur D. Little, Inc., under an Office of Naval Research contract.

It's an excellent job of fact-gathering, done carefully and by men who knew the fields they were studying. It's a job that has needed doing—essentially, a report of research-about-research.

And it isn't going to have much of the desired effect.

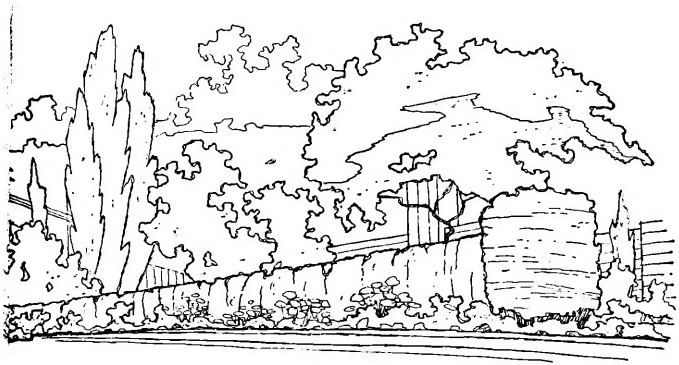
The intent is to show that it is vitally necessary to invest more time-effort-money in basic research—research not channeled or directed

(*Continued on page* 173)

A Right must imply a choice. When all men are mortal, Death is not a Right. But when there is—

IMMORTALITY.

Illustrated by van Dongen



...FOR SOME

By J. T. McINTOSH

HE WAS on the run again. This time there was no exhilaration in it, only a dull expectation of defeat. You couldn't hide in society from society forever.

His greatest advantage had always been that the police, smugly certain that there couldn't possibly be any crime they didn't know about and hadn't already solved, were always slow to investigate things they decided were none of their business.

Another big advantage had been that so far he had always been alone. This time he wasn't alone. As he sat on the beach under the blazing Flor-

ida sun, he waved occasionally to a girl in a silver swimsuit who was bathing in the shallows.

If the police weren't looking for him, he was still safe. But this time the police would be looking for him, and that meant that at any moment a heavy hand would drop on his shoulder and his freedom and his life would be over.

Thinking back, he couldn't put his finger on any mistake he had made, any avoidable mistake. Of course, if he hadn't gone to the Blue Moon night club, things would have been different. Lacking second sight, however, he could hardly have known that. It might have been better if he had given Marita a false name. But then, giving a false name could be even more dangerous. You couldn't stop people who knew you under one name meeting people who knew you under another.

A bronzed young Adonis ran into the water, straight for the girl in the silver swimsuit. Ignoring him, she blew a kiss up the beach, and the self-confidence of the Adonis faltered. He swam out past her.

The man on the beach waved back. She was in love with him, obviously. He wondered if she knew he wasn't in love with her—if she was going to be hurt.

Barely a dozen feet from him the air crackled. Sometimes that happened when you were being peeped by transmitterless TV. Feeling an impulse to jump up and run, he fought it down. If it *was* TTV, the more unconcerned you could be the better. What you had to remember was that when the air popped, that was like seeing a cop. Naturally you'd soon land in trouble if every time you saw a cop you took to your heels.

All the crackle meant was that someone had looked at him. That might be the end, it might be the beginning, or it might be an abortive, unimportant episode in the course of a search for somebody else.

Two women passed him, walking along the beach. Neither of them could afford to wear swimsuits, but both were wearing them. One said:

"See that girl in the silver bathing costume? That's the type I mean."

"What type?" the other asked.

"Too naive to be true. Baby blue eyes. Curves she pretends she doesn't know about. I bet she's forgotten more about men than you and I ever knew."

It was amazing, the man on the beach thought, how shrewd women could be about women. That one had sounded just like Susan Sonnenburg.

Susan Sonnenburg . . . in a way it was her fault he was on the run again. Although Susan had ceased to exist more than a week ago, Susan had unwittingly set things in train which had resulted in the present situation. Why hadn't she minded her business?

"Right to the front door, please," said Susan Sonnenburg firmly, as the cab dipped to land a block away from the Musicosmos Building.

"Sorry, lady, I got no VIP license," said the cab pilot. "If I touched

down on the Musicosmos frontage, the air would be blue with cops before you could get the door open."

"No, it wouldn't. I have a card."

"O.K., let's see it."

"I'm not going to rummage for half an hour in my bag. Kindly take my word for it."

"I ain't taking no chances, lady. You can walk from here."

"I most certainly can *not* walk from here, and I don't intend to try. At my age I get quite enough exercise changing my mind."

The pilot grinned. "Say, if you rate a card, I should know your name. Who are you, lady?"

"I said I had a card," said Susan. "You very rudely doubt my word. Why should you believe me if I tell you I'm Martha Washington?"

The pilot suddenly thought of something and looked down at her hands. Obstinately, perversely, she put them behind her.

But his face had lighted up. "You are Susan Sonnenburg, the pianist," he said. "I got your record of that Chopin sonata, the one in D Flat."

"B Flat Minor," said Susan.

"Have it your way. Five flats anyway. You play the funeral march too fast. But sure, you got a card. I'll land you right away."

The cab hopped the block to the Musicosmos Building and dropped gently toward the reserved landing lot.

"I don't play it too fast," Susan retorted. "You just listen too slowly."

"And the movement before that," said the pilot, "the one with the chromatic chords running up, you take like a funeral march. When it comes to the bit that ought to go faster, you keep it the same speed."

"You ought to hear me play Minuet in G," said Susan acidly. "I often get some of it nearly right."

The pilot touched the button that opened the door. When Susan opened her purse he shook his head. "This one's on me, Miss Sonnenburg. When I said you played the second movement too slow and the third too fast, I didn't mean I didn't like it."

"Well, there's no need to rave enthusiastically about my performance like a lyric poet," said Susan sarcastically and hobbled inside, leaning on her stick.

The Musicosmos Building swelled to heaven like a hymn of praise. Music made money these days, even serious music. Some people said the change had come when the schools started to teach children not to be scared of thinking, not to be afraid of being different, not even to be ashamed of secret cravings for taste and culture. Others said that when detection and punishment not only caught up with crime but got 'way ahead of it, what was there to do but make strictly legal love, read books watch TV and even listen to Beethoven and Brahms? A third group, the supreme optimists, said Who knows—maybe the human race is maturing at last?

Sixty years after Borodin died his music was made into a hit musical consisting mainly of lush blondes

brunettes and redheads wearing diaphanous pants and jewels. Two hundred years after Borodin died his second symphony, in its original form, topped the hit parade. It all went to prove something.

Old Benny touched his cap to Susan as she entered the building. He was even older than she was, nobody knew how old.

"They're ready for you in Studio Seven," he mumbled, shook his head for no obvious reason, and gave her his arm. Susan took it gratefully.

She had had a bad fall eight months before, and although it had been easy enough to pin the broken bones, she'd been hardly as good as new since. Curiously enough, as science made things easier for the average person, things became tougher and tougher for the semi-cripple. In the Nineteenth Century if you were old and tottery—and rich—you'd have servants to help you around and wrap you up and even carry you if necessary. Now there wasn't a personal servant left in the United States, and you had to walk farther—because of the parking problem—climb more stairs—since there were no pedestrians on traffic lanes any more—and cope with more high steps—cabs, buses, escalators—than any Nineteenth Century lady of advanced years had ever had to do.

It was for that reason that Susan had always appreciated the shambling but gentle helpfulness of Old Benny. As this was the last time she would need it, she stopped suddenly, unable to let the occasion pass without some word of thanks.

"Benny," she said. "I'm an old woman, and crotchety, and dried up. Why have you always been so nice to me?"

The abrupt question was too much for him. His vacant, friendly face registered bewilderment and conflict. He seemed to feel something was demanded of him but had no idea what.

"Never mind," said Susan with unusual gentleness. "I want to tell you I've appreciated your kindness, anyway."

"Kindness?" said Benny, still bewildered.

"Like now. Like getting cabs for me and making the pilots bring them right to the front door. Like fixing a room for me that day I felt sick. Like cutting a bit off my stick when I said it was too long. Like bringing me sandwiches at a long rehearsal. Like—"

"It's my job, Miss," said Benny, embarrassed. "I'm caretaker, odd-job man. Most of the day I don't have nothin' to do. So I—"

"So you help anybody who needs help. I know. I guess I'd have gone on for years taking you for granted, Benny, only today something made me realize how much you'd done for me, in a lot of little ways."

She hesitated, for what she wanted to tell him was rather like telling a hungry man she had just had dinner and now she had to go to a banquet. But she couldn't just disappear without a word, without saying good-by.

Old, inarticulate, not too bright and awkward as he was, she liked old Benny.

"Today is the last time I'll be here, Benny," she said quietly, her usual sarcasm absent. "I'm making my last recording today, then going for Rebirth."

The sudden blaze in his dim eyes startled her. But all he said was: "Yes, Miss Sonnenburg."

"I once hurt your feelings by offering you a tip," she said. "I'm not going to do it again. I know you don't do things for any reward. But have you ever heard of an honorarium?"

"Orrorrarian?"

"Sometimes when someone's done something over and above his duty, or his job, or his obligations, people want to express their gratitude somehow. So they give him something and call it an honorarium. That isn't like a tip. Anybody can accept an honorarium."

"What does an orrorrarian look like?" Benny asked doubtfully.

"All I can give you is money. But you can take it and buy anything you like, and whatever you buy will remind you of me. Thanks, Benny—and good-by."

She left him outside Studio Seven, three crumpled notes in his hand. Painstakingly he smoothed them out.

Two hundred and fifty dollars.

They weren't ready for her in Studio Seven after all. Collini, the conductor, hadn't finished shaping the *tuttis*.

Most recordings were like jigsaw puzzles since the advent of wave matching. Although some old-fashioned conductors and performers still adhered to the old hit-or-miss methods, what usually happened these days was that a master was prepared, a blueprint for a particular performance, a sort of picture of the desired orchestral sound. This visual master could easily be transferred direct into sound, but, if it were, it would be of interest only to music students. It would be entirely too mechanical for anyone else.

When the master was complete, the orchestra would record the music and an automatic process of comparison would be carried out. The machines would ignore the nuances of expression and phrasing which they didn't understand, but would point out the factual, measurable differences which they did—where the second trumpet played an E natural instead of an E flat, where the second violins swamped the firsts, where somebody in the woodwind squeaked during a rest. The engineers, conductor, soloist if any, and supervisor would go over these points carefully, deciding what didn't matter, what they preferred as played to what was on the master, and what would have to be done again.

This system didn't produce music of any greater artistic worth, it merely produced much more immaculate music much quicker.

Collini hadn't quite completed his orchestral master, so Susan withdrew to a rest room off the studio while

he did so. To her disgust, Weygand followed her.

"So this is the last Susan Sonnenburg recording session," Weygand sighed sententiously.

"When you make a statement like that, Mr. Weygand," said Susan, "one cannot but agree with you."

He was a fussy, conventional little man. Indeed, his job was to be conventional. He was one of the directors of Musicosmos, and what he liked, nearly everybody would like.

"The Mozart G Major, Köchel 453," Weygand mused. "One could have wished the last work you recorded could have been something grander and nobler—Beethoven's 'Emperor,' for example. But then, we have the 'Emperor' you recorded fourteen years ago."

"As you say."

"Aren't you a little sad—a little regretful?" Weygand asked. "After all, you probably won't be a pianist again. You may not even be a musician. You may not be famous."

If she shocked him, he might go away. "On the other hand, I won't have to go to bed alone any more."

Weygand had a literal mind. "Yes, you will, for years yet. At least four years."

Susan resigned herself to the conversation. If she was honest with herself, which she usually was, she was forced to admit that the only real reason for her dislike of Weygand was the practical musician's contempt for the theoretical musician. Plus the fact that you always knew what he was going to say before he said it.

"I've done most things a pianist can do in music," she said. "I wouldn't want to do them all over again."

"Wouldn't you?" said Weygand wistfully.

"Maybe this time I'll be a jazz trumpeter or a blues singer."

Weygand sniffed. "That wouldn't be right. You're a great artiste, Miss Sonnenburg."

"I've got a fair rating on the mechanical side. Perhaps I'll turn out to be a physicist or a doctor this time."

"A scientist!" said Weygand, horrified.

"Oh, it's all right," Susan reassured him blandly. "According to my rating, I wouldn't be a very good one. That makes it all right, doesn't it?"

Weygand was struck speechless—a consummation devoutly to be wished. She enjoyed the silence until suddenly she thought of something Weygand could and would do for her. "Mr. Weygand," she said, "you know old Benny?"

"The caretaker? Of course."

"Would you do something for me? Would you have him tested?"

"What do you mean, tested?"

She could hardly say: For Rebirth. The idea was too fantastic. Rebirth was the prerogative of the Top Ten —the top ten per cent of the population on the VTC scale (value to the community).

Ten per cent was a pretty wide band, really. Susan, of course, was well up in the top one per cent on the VTC scale. Everybody she knew,

all her friends would qualify. Any college graduate, any executive, any artist, writer, musician, technician, doctor, nurse—indeed, practically anybody who had achieved moderate success in anything—was almost sure to qualify for Rebirth.

Everybody Susan knew, except Benny.

She couldn't explain to Weygand, of all people, the feeling she had. The feeling, the intuition, the hunch that there was more in Old Benny than met the eye. She was well aware that she was biased—she liked Benny, and he might die at any moment, strong and healthy though he appeared to be for his age. It was natural for her to want Rebirth for him for no more reason than that he was a good Joe.

Yet she was sure that there was more to it than that. The VTC scale included intelligence, a wide variety of talents, and among many other attributes a thing called affinity, sometimes called empathy. In a word, this meant that though Rebirth eliminated all psychosis anyway, a good Joe was always more likely to qualify, other things being equal, than the kind of fellow who tore the wings off flies.

Benny would rate high on affinity, if nothing else.

"You know what a test is," she said irritably. She didn't want to say the VTC test. That was for Rebirth.

"The musical capacity tests?"

"Sure, they'll do," she said. The MC tests were for an entirely different purpose, but they included a sketchy intelligence test and an even sketchier personality rating. If Benny turned out to have any talent or capacity or intelligence or potential, the tests would show it, and sending him for a VTC rating would be a matter of routine.

"Anything you say, Miss Sonnenburg," said Weygand. "You trying to prove something about Benny?"

Susan dodged the question. "You'll do it?"

"Of course."

One of the engineers tapped on the door and opened it. "Ready for you now, Miss Sonnenburg," he said.

It was no ordinary session. Everybody knew that immediately it was over, Susan was going straight to the Rebirth Institution. Although that wasn't death, although only relatives and female ones at that cried when somebody went there, although everybody who rated Rebirth was cordially thankful and everybody who didn't wished passionately that he did, in some ways it was just as final as death. Susan Sonnenburg the pianist would be just as dead as if she dropped away from the piano keyboard now with heart failure. She wouldn't be told that she had ever been Susan Sonnenburg unless the psychologists decided it wouldn't do her any harm to know, and the psychologists were known to have a bias against such disclosures.

They had to be pretty careful over the wave matching, for there could be no re-takes, not of Susan's part anyway. Curiously, when everybody was ready for a long and hard ses-

sion, everybody hit top form at once and hardly anything had to be done again.

When Susan saw that her solo part was safely taped, she turned and went out through the rest room so casually that Collini and Weygand and everybody else assumed she was merely going to the washroom. But she went right on out of the building, avoiding even Benny.

Susan didn't like farewells.

The cab pilot who took her to the Rebirth Institute was surprisingly casual, too. "Sure, you're the pianist," he said. "Guess I'd better be specially careful. You don't want to get killed on your way to Rebirth."

"As you say," Susan agreed.

"I'm coming here myself in about sixty years. You wouldn't think a cab pilot would rate Rebirth, would you?"

"So you'd better be even more careful. We don't both want to lose our chance of immortality, do we?"

They didn't. As Susan hobbled into the big square building which was

the Rebirth Institute she sighed gratefully at the thought that the next time she had to walk she'd be able to run if she liked.

Weygand picked up the phone. "Yes, this is Weygand of Musicosmos. Rebirth Institute? Yes, of course . . . Benjamin Rice? He could be on the staff here, but the name doesn't ring a bell. Susan Sonnenburg named him as what?"

"We usually question people who were personal friends of our subjects," the quiet, anonymous voice said. "Their own information about themselves is too subjective, of course. Miss Sonnenburg said this Benjamin Rice, Musicosmos, could help us."

"Let's see, it's been three days since she went for Rebirth," said Weygand. "How's she coming?"

The anonymous voice seemed faintly surprised by the question. "As expected, Mr. Weygand. A routine case. No complications. Now, this Benjamin Rice—"

"Wait a minute. Could that be old Benny? Look, I'll make inquiries and send over Rice, whoever he is, just as soon as I can. O.K.?"

"Thank you, Mr. Weygand."

On the house phone Weygand called Personnel. "Who's Benjamin Rice?" he asked.

Checking took less than a minute. "One of the caretakers, Mr. Weygand. Do you want his file?"

"No, that's all, thanks."

He rang Benny's tiny office. "Benny? This is Weygand. The Rebirth Institute just called. Miss Sonnenburg left your name there. Seems they want to ask you some questions. Now don't get worried, there's nothing wrong. Just routine. Will you go over there right away? And Benny—"

He had just remembered, guiltily, that he had promised Susan to have an MC test run on Benny. He hadn't forgotten; he had merely not remembered.

"It doesn't matter," he said, and hung up. He'd call Walter Jennings of the testing bureau and Jennings would send for Benny when he was ready. In fact, just to make sure the matter didn't slip his mind, Weygand picked up the house phone and called Jennings right away.

Benny took his coat from a hook and put it on slowly, thoughtfully. Something crawled inside of him at the thought of going to the Rebirth Institute. However, there was no help for it. He left a note in bold block letters on his table, OUT ON BUSINESS, and walked out.

Benny Rice was over a hundred years old, and sometimes in the Musicosmos Building he looked it. But as he walked to the Rebirth Institute—it didn't occur to him to take a bus or cab, although the distance was two miles and either Musicosmos or the Institute would certainly have paid for the ride—he gradually straightened, his eyes brightened, his chest expanded, until by the time he had walked a mile he could have passed for fifty. Since the normal expectation of life these days was about one

hundred seven, a man of fifty was quite young.

Physically, Benny was a remarkable specimen, so remarkable that to avoid notice at Musicosmos, where they knew exactly how old he was, he habitually moved a little more slowly and much more awkwardly than he might have done. Outside Musicosmos he was always prepared to pretend to be fifty if he could get away with it. He usually could. With luck, he had another forty years of life remaining to him.

The Institute from the outside was a cold, white, bare, impersonal building. Inside, the difference was startling. The furnishing and design suggested a luxury hotel rather than a hospital or a nursing home.

"Benjamin Rice?" said the smart blond receptionist. "That's right, Dr. Martin wants to see you. He's out in the gardens. Sammy here will take you to him."

Sammy was a redhaired youth who didn't talk. This puzzled Benny, for Sammy looked friendly and chatty. "What's the matter, son?" he asked, as they emerged into the gardens behind the Institute. "Cat got your tongue?"

Sammy gave him a look so alive with intelligence and mischief that Benny expected a smart retort. But what Sammy said was: "Da-da."

Benny understood then, and grimaced at his own dumbness. Sammy, of course, was one of the Reborn. He had all the intelligence he would ever have; he just hadn't learned to talk yet.

The receptionist was probably another Reborn. Naturally, if the Institute had to keep people in their care for nearly four years, they'd put them to work.

Dr. Martin looked no more than twenty, but he couldn't be a Reborn. Rebirth wasn't run like an exclusive social club. Although necessarily the Reborn had to be kept together to mature and re-acquire the basic information which every intelligent citizen was assumed to possess, as soon as possible they were dispersed far and wide and mingled with the rest of society again. Martin wouldn't be a Reborn because no young Reborn doctor would be encouraged or allowed to hide himself from the world in the Rebirth Institute. It would be like going back to the womb.

He looked up with a grin. "Benjamin Rice?"

"Everybody calls me Benny."

"Sure. O.K., Sammy, you can go back to the desk."

They were standing on a huge lawn on which scores of deckchairs were arranged in neat rows. Although there were no nurses and no supervisor except Martin, the scene looked normal enough at first, like any lawn in any rest-cure sanatarium. But then one noticed that all the occupants of the deck chairs were about fourteen, that they were all in the deep sleep of heavy sedation, and that they all, boys and girls, wore plain white smocks. The white smocks, like baby doll pajamas except that there was no attempt in cut

or trimming to make them look attractive, were strangest of all, for it was obvious that no ordinary boys or girls of fourteen would consent to wear them if they had any choice in the matter.

Clear-skinned and healthy though they looked, these overgrown infants had minds as empty as a scarecrow's pocket. The boys didn't even know they were boys, nor the girls that they were girls.

"You work at Musicosmos, Benny?"

"I'm the caretaker."

Martin seemed puzzled. "How did you get on with Miss Sonnenburg?"

"Swell, doctor. She was a fine lady. I was sorry when she came here."

"Sorry? You wouldn't want her to die, would you?"

"She was a fine lady," said Benny vaguely.

Martin was more puzzled than ever. Susan had filled in Benny's name on the reference sheets as a friend who could be consulted if necessary on her personality, behavior, and temperament. Martin had assumed that Benjamin Rice would be a colleague of Susan's, a musician, writer, artist or something of that sort.

"Tell me about her," Martin said encouragingly.

"She was always nice to me. She said I was nice to her, but I don't know what she meant. Of course she couldn't get around so well, not since she fell that time, and I helped her around, little things like that. They said she was a great pianist, but I wouldn't know about that. All I know is, she was a fine lady."

Martin was silent. It was obvious that Benny wasn't going to be able to tell him anything useful. Presumably Susan Sonnenburg had entered Benny's name as a joke, just as under "Other Activities" she had put down *tiddleywinks.*

It would be easy enough to find plenty of other people who had known Susan Sonnenburg well. The interesting thing was that Susan had elected to put down Benny's name. Was it just a pointless and rather tasteless joke, or was there something back of this?

"How long did you know Miss Sonnenburg?" he asked idly.

"Just a year. No, a little less. I went to Musicosmos last September."

So that was that. Martin discarded the idea that Sonnenburg and this old man had once been lovers, long ago. It was a pretty fantastic idea anyway.

Martin stood up. He'd have to find someone else to give some impressions of Sonnenburg for the case book. Benny was a nice old fellow, but not very bright.

"Would you like to see Miss Sonnenburg now?" he asked.

Benny took an involuntary step back. "No," he exclaimed vehemently.

That was interesting. Could they have been lovers, long ago?

"She isn't Sonnenburg any more. But if you liked her, Benny, I think you should see her now. She's different, of course. Still, I think when

you've seen her you won't feel so bad about it. There's a lot of happiness ahead of her."

Unresisting, Benny was led across the lawn. Martin stopped beside a deck chair and pointed. Benny caught his breath.

The girl in the chair, in a deep, drugged sleep, was about fourteen, like all the others on the lawn. Her smooth, pretty face was vaguely reminiscent of Susan's. It was full of intelligence and absolutely empty of experience. But for the intelligence in it and the hint of a sense of humor, it was the face of a beautiful idiot.

Rebirth was a convenient name for something which was nothing of the kind. People weren't reborn, they were wiped clean and rapidly refurbished in a culture tank. The clocks of their lives were set back eighty years. They got new cells for old, youth for age. To pay for it they had to give up all they had ever known.

The girl who slightly resembled Susan wore a plain smock which made no concessions to sex. Her body, although barely nubile, was at least as beautiful as her face. She looked like a newlyborn child who somehow had the body of an adolescent, which was pretty near the truth.

Betty Rogers—Martin was careful not to mention her new name to Benny—had all the talent, capacity and intelligence of Susan Sonnenburg. Whether she would turn out to have the same personality was anybody's guess. In a particular case, no one could say how much of the personality grew from heredity and how much out of environment, Betty and Susan had the same heredity, but environment was going to treat them very differently. Probably Betty would be happier than Susan and would accomplish less. But it was quite possible that Betty would accomplish even more.

"I thought she'd be a baby," Benny said hoarsely.

Martin shook his head. "We could do that, but it's unnecessary and even undesirable. We've improved on nature. In nature a child takes twenty years to grow up mentally and physically. We can teach them enough in four years. At eighteen, she'll be in no way inferior to a girl who's had a normal birth and childhood. We don't take them back the other side of puberty because we have enough time as it is and this way we avoid a lot of emotional problems. It's almost certain—"

His voice trailed away. He'd been talking as if Benny had turned out as he expected. The old man's bewilderment showed he was wasting his time.

Martin led him back across the lawn. "Thanks for coming, Benny," he said. "You've been a great help. I just want to talk to a few people like you who knew Miss Sonnenburg well. Now, maybe you can tell me who I should see next?"

"You should see Mr. Collini," said Benny, proud to be consulted. "He's

a conductor. Miss Sonnenburg worked with him a lot."

"Thanks, Benny. I'll do that."

On the way back to the Musicosmos Building, Benny slouched and looked his years.

Susan Sonnenburg was gone. The beautiful half-child half-woman he had seen was not Susan Sonnenburg and would never be Susan Sonnenburg.

But strangely enough, that hardly affected Benny and was not responsible for his depression. After all, Susan had been at an age where death at any moment was a possibility, approaching an age when death was a certainty. (Only five years younger than he was.) She was not more dead now than she would have been if she had actually died. By reckoning, she must be less.

When Benny got back to his single room that evening, he took out the two hundred fifty dollars Susan had given him, untouched so far, "Buy something that will remind you of me," she had said.

He didn't want to be reminded of her. There was no point in remembering her. The sensible thing was to put the money with the rest and forget where it came from.

He took a large envelope from behind the old-fashioned dressing table and looked in it. Two thousand dollars. He didn't want or need more. Closing the envelope, he put it back. The money Susan had given him was still on the table.

Susan Sonnenburg was gone, finished. He would get rid of the money she had given him as quickly and completely as possible. Scatter it to the winds. Keep nothing of it, not as much as a book of matches from a night club.

Night club. He hadn't been in one for twenty years. He wouldn't end his life heartbroken if he never entered one again. Still, when you were trying to get rid of money without actually burning it—

From a cupboard he produced evening clothes which were cheap but well-cut, so well-cut that when he put them on they entirely ceased to look cheap. They also made him look younger—not in years as much as in spirit. A man of seventy dancing a jig looks much younger than a man of sixty in a bathchair. People might still estimate Benny's age pretty accurately. Nevertheless, he would look less out of place with girls of twenty than many men half his age.

He was not unaware of this.

Whistling contentedly, if not particularly tunefully, as he dressed, he thought without regret about Susan. It was easy to get sentimental when people died or went for Rebirth, but the truth was that neither Susan nor anybody else for the last twenty years had ever come close to being a friend of his. He couldn't allow that. He might allow women to fall in love with him, if they could and would; he couldn't allow anyone, man or woman, to become a friend.

But Susan could have been a friend.

Ready for the pleasures of the evening, he had a good meal at a restaurant nearby, lingering over it. It wasn't a big meal, but it was a well-chosen one, washed down by a bottle of Yugoslav Riesling.

Then he went to the Blue Moon. Before going to the bar he paused to watch the floor show for a few minutes. A magician with some electronic tricks in keeping with the Blue Moon's cover charge was getting far less attention than he deserved. Some of his gadgets were radio-controlled. When he blindfolded himself he used radar. And all his animals were beautifully designed robots. Someone should have told him to be old-fashioned and put a few girls in the act.

There were two girls at the bar as Benny approached it, one in pink whose lines were uncertain and one in red who showed how the other's ought to have gone.

"Hi," said the girl in pink.

Benny's smile for the pink girl was much brighter and friendlier than the look he gave the girl in red. Yet he made the situation clear in the nicest possible way, and the pink girl sighed philosophically.

"This is Marita," she said. "Buy me a drink and I'll blow."

Marita didn't look like what she was, any more than the top members of her profession throughout history had looked like what they were. Apart from fitting her like suntan, her gown was decent, and she looked intelligent.

When he arrived at the Musicosmos Building next day, nothing remained of the money Susan had given him except a slight hangover and a feeling of lassitude natural enough in a man of his age.

Jennings dropped a file on Weygand's desk. "I did that test you asked me to do—on Benny Rice. Want to look at the results?"

"Not unless there's anything interesting in them. Is there?"

"Depends what you call interesting."

Jennings was a tall, untidy man who spent most of his life looking tired and disinterested, grinding along like a motor working on low voltage. Now and then, however, something would excite him. Immediately he would get the right voltage from somewhere and would sparkle like champagne.

His disillusionment arose out of the fact that few people understood or cared about his subject. He spent half his life explaining that his tests were meant to isolate *potential.* If somebody had an astronomical M.Q. of 185, that didn't mean he'd be a great composer, or recording star, or conductor. It merely meant he had an M.Q. of 185. Other things being favorable, he might amount to something musically. Other things being exactly right, he must amount to something, if he started soon enough and on the right lines. Other things being in any way unfavorable, he'd make a good bus driver or clerk.

"Well, is he a musical moron?" Weygand asked.

"Not quite that. A musical moron would have an M.Q. of 70-80. Benny's 42—that makes him a musical imbecile."

Weygand sighed. "Thanks, Jennings."

"What was the idea, anyway?"

"Susan Sonnenburg wanted him tested. Feminine intuition, I guess."

Jennings momentarily lost his harassed look and genuine enthusiasm came over him. "If Susan Sonnenburg requested it, I know what she was thinking about. Rebirth. She'd sensed that Benny wasn't as dumb as he looks. And she was right."

"You mean he's a Rebirth prospect? With an M.Q. like that?"

The harassed, tortured look settled back on Jennings' face. "President Fuller has an M.Q. of 61," he said. "That doesn't stop him being almost off the top end of the VTC scale."

Weygand's eyebrows indicated mild, not particularly interested surprise. "My M.Q. is the same as my VTC rating."

"And you're in a musical administration job."

"So what?"

An expression of agony crossed Jennings' face. Sometimes he wondered why he bothered.

"Want me to run a VTC test on Benny?"

"If he had a high rating, it would have been discovered long ago, wouldn't it?"

"Oh, sure."

"Then forget it. I've done all Susan asked me to do."

But Jennings didn't forget it. As he returned to his own department, he was mentally revising his assessment of Benny. Told nothing of the background, he had assumed the test had been requested because somebody thought Benny had musical ability. Well, he hadn't—to put it mildly.

Jennings had known Susan Sonnenburg quite well—in one respect, better than anyone else. He knew her test ratings. M.Q., 141 ("Only 141?" Weygand had said once. "That just shows what your tests are worth, Jennings. She's the greatest pianist in the world." Jennings had tried to explain how an M.Q. of 141 or even less could be enough for someone of Susan's intelligence and tenacity. You needed more than potential to achieve success in anything). I.Q., 155. Mechanical ability, 139. VTC, 198.

Damn it, there was nothing wrong with the tests if only you used them with a grain of sense. Those three figures of Susan's told a clear story—I.Q. 155, mechanical ability 139, VTC 198. Obviously she rated pretty high on intuition. There still wasn't any way to test intuition directly, but like radium in pitchblende it could be inferred. If 141, 139 and 155 averaged out at 198, there was some radium around somewhere.

Jennings, a mathematician and a scientist, was prepared to back Susan's hunch about Benny. Not that he cared about Benny as a person. What interested him was the operation of the testing system.

Back in his office he phoned a request to the Federal Rebirth Institute for Benny's registered VTC rating. In fifteen minutes it came back: 31.

When he saw that he caught his breath. His eyes glowed as he switched on his own auxiliary power supply and became a human bulldozer. There was something here that had to be investigated, something that wasn't right.

The VTC rating of 31 was impossible. Benny was a musical imbecile, true. The rest of the tests hadn't shown him up as any kind of genius, either. But a VTC rating of 31 meant someone was unemployable—far below the capacity of a caretaker. There was something strange here. Something strange and exciting.

Jennings sent for Benny again. He came at once. "You wanted me, Mr. Jennings?"

"Yes, sit down there, Benny. I guess you wondered what that test this morning was for. The truth is, Susan Sonnenburg requested it. She didn't say why, but my guess is she thought you'd rate Rebirth."

"I don't," said Benny simply. "And I'd rather not go into it again, if you don't mind, Mr. Jennings."

"Just for curiosity," Jennings

said, "I found out your official VTC rating, Benny. It's 31. Now that's impossible. Take my word for it, it's all wrong. Tell me, do you remember anything about that test?"

"Not much. It was seventy years ago."

Jennings leaped to his feet. "If you really rated 31, Benny, you wouldn't remember it was seventy years ago. You wouldn't be able to calculate it was seventy years ago. Understand?"

"If you say so, Mr. Jennings."

"What else do you remember about the test seventy years ago? Was there anything special about it? Were you sick, or anything?"

"I don't remember, Mr. Jennings."

"Would you like to do that test again?"

"No, Mr. Jennings."

The blunt, unequivocal answer threw Jennings for a moment. "But, Benny, that rating's all wrong. It must be. I can't promise anything, of course, except that you must be a lot higher than that. How much higher I don't know."

The top ten per cent were those above 120. It was highly unlikely that Benny was anywhere near 120, and Jennings had no desire to raise the old man's hopes, even with Susan Sonnenburg's hunch to go on. But the test had to be carried out.

"Look, Mr. Jennings," said Benny appealingly. "All my life I've known Rebirth wasn't for me. I've grown old knowing other people could look forward to it, but not me. Long ago I came to accept that. I've taken it for granted for so long I don't want Rebirth—can you understand that?"

"Well, you don't have to have it. People aren't forced to go for Rebirth, you know—unless their rating is so high that society just can't afford to lose them. Benny, I want you to take the test just to set the record straight. Your VTC rating isn't really 31, and never was. Suppose it's 70 . . . 100 . . . even 110. Wouldn't you like to know that—just so you won't go on thinking you're a no-good never-was?"

Benny shrugged. "If you like, Mr. Jennings. Anything you say."

Later that day Jennings had the result. He stared at it incredulously. VTC, 30.

He didn't know what to say to Benny. Now that it had happened, now that there was no conceivable doubt, possible explanations suggested themselves to him.

Just as Susan Sonnenburg could total more than the sum of her parts, Benny could total less. I.Q. 98. M.Q. 42. Mechanical ability, 116. Mathematical ability, 126—an incredibly high rating for a caretaker, that. Self-assertion, 41—just as incredibly low, that one. Memory, 110.

Nothing on the card lower than 41, rising through 126, and the VTC rating was 30. It could have been criminal, psychotic, antisocial tendencies that brought the figure down, but it wasn't. The antisocial tendency figure was neutral.

Jennings solved the problem of what to say to Benny by not seeing

him at all. He merely sent down a note saying the new test confirmed the old one.

Then he tried to do what Weygand had told him to do—forget Benny.

Benny's single-room apartment was twenty minutes' walk from the Musicosmos Building. As he walked home, he was wondering whether to leave Musicosmos. He was cool, unalarmed. Unworried, he weighed the two sides of the question.

On the one hand, once people started getting interested in you they usually went on until they found out altogether too much. On the other hand, if you stood your ground for once and brazened it out, all curiosity about you might be stilled forever and you'd be safe as you'd never been before. People didn't look where they'd looked already. You wouldn't know about that—you'd always run out when things got too hot.

Just as he was deciding that this time he'd stay put as long as he could, he became aware that he was being followed.

His steps didn't falter. Who would follow him? Only someone who did not know too much about him. Anyone who knew more would be aware that he was simply walking home from Musicosmos, as he did every day, and that there wasn't the slightest need to follow him.

Maybe he'd made a mistake in that VTC test.

Why had they tested him, anyway? He had thought it was merely something to do with Susan Sonnenburg, that she'd arranged a test under the impresssion that she was doing him a good turn. But if so, who was following him now? Susan was in the Rebirth Institute, and had long since ceased to know or care anything about Benny Rice.

Deliberately passing the newsstand where he usually bought a paper, Benny acted as if he'd suddenly remembered it and went back for it. That gave him a chance to get a good look at the man tailing him. He was between thirty and forty and the most nondescript individual Benny had ever seen. Even looking straight at him Benny could hardly decide on any feature that might help to identify the man later. Catching Benny's gaze, he stared back so indifferently that for a moment Benny thought he had been mistaken.

But he hadn't been mistaken, he realized. This man was a master at his job. He was so good that Benny wondered if he'd been allowed to realize that someone was following him, simply to see what he would do.

No longer unworried, Benny made his plans in a flash. He had to go to his room, for his money was there, his escape money. But the last thing the detective following him would expect was that he would bounce out the moment he went in.

Gone forever was the possibility of staying put and brazening it out. When top-grade detectives followed you around, it was too late to rely on the pretense that you were a dumb ancient caretaker, VTC 30. When top-grade detectives followed you around,

you just weren't a dumb ancient caretaker, VTC 30, and you'd never manage to convince anybody that you were. It didn't matter who was employing the detective or why; once anybody got that far his goose was cooked.

The detective wasn't police, for the police would peep you with TTV. His best chance was to be far, far away before the cops became interested.

He was on the run again.

When Benny Rice didn't appear at Musicosmos the next morning, the matter wasn't sufficiently important for anyone to pay much attention. Certainly his nonappearance wasn't reported to anybody as important as Weygand or Jennings.

It was only when a woman came round making inquiries that the blank-eyed porter who took Benny's place at the door linked the events of the last few days and called Jennings in the testing Department.

"There's a woman here asking about Benny, Mr. Jennings," he said. "You've had him up there a lot lately. I wondered if maybe—"

"What do you mean, asking about Benny? Isn't he there?"

"No, he ain't here. Ain't been in all morning. I thought you—"

"What's the woman like? Old?"

"No, young." The porter, who had not been young for a long time, left it at that.

"Send her up."

Jennings was surprised to meet a girl in her twenties who was obviously a professional beauty of one kind or another. She introduced herself as Marita Herbert.

"Sorry to trouble you, Mr. Jennings," she said. "I'm interested in Benny Rice. I want to find him, that's all."

"Why?"

Her smile didn't go, but it froze a little. "Frankly, Mr. Jennings, I don't see that that's any concern of yours."

Jennings shrugged. "If you want me to help you find Benny, you'll have to tell me something. I'm not in the slightest interested in your affairs, Miss Herbert. But I'm still very interested in Benny."

"Still?"

"Why do you want to find him?"

She shrugged ruefully, almost irritably. "I met him the other night. He's three times my age, but he did things to me. I want to see him again. I have to. I even had a detective find him for me."

Jennings swallowed. "You're in love with him?" he asked incredulously.

"Not that. Not exactly. Can't I want to see him again without being in love with him?"

"You said you had a detective trace him. Didn't you know where he lived?"

"I only knew his name. The detective I hired found he worked here. They tell me he's a caretaker, but that can't be right."

"Why not, Miss Herbert?"

"Well, the other night he was spending money like water."

"Perhaps he won it on a horse."

"Maybe, but— Well, he's nice. Understanding. Clever, but not clever the way a professor is clever. Good at guessing. Educated. And he has taste."

Startled, Jennings said: "Many such men are caretakers."

"Are you kidding? Maybe you think I'm dumb, and wouldn't know class when I see it? Look, Mr. Jennings, I want to see Benny Rice again because . . . well, in just a few hours he made me see things differently. He gave me back my self-respect, understand? I need him like some people need to go to church. Do you have the faintest idea what I'm talking about?"

Jennings thought of Benny's VTC rating: 30. He had given up too soon. Of course that figure was incredible, just as he had told Benny before the test. He wanted to think.

"Leave your name and address, Miss Herbert. We'll let you know about Benny once we've done some checking. We'll send somebody to his apartment."

She shrugged. "You can save yourself the trouble. He isn't there. Seems I know a heck of a lot more about him than you do."

"What do you know, Miss Herbert?"

"I've told you. He isn't at his apartment. Silver, the detective I hired, phoned me last night to tell me he'd just followed Benny to his apartment. Seems that while he was doing this, Benny was walking out. And nobody's seen him since. That bright private eye of mine says he has some clues, but I'm not counting on it."

When she had gone, Jennings' eyes were alive again.

Somehow or other Benny had faked that VTC test. He must have, because the Benny Jennings knew bore little or no resemblance to the Benny whom Marita Herbert had met.

In one way Benny had done an extraordinary job—any ordinary attempt to fool the test would show up like a sore thumb. In another way he had been astonishingly dense. Why should anyone who had the brains to fool the test and the testers be such an idiot as to get himself a rating of 30? If Benny merely wanted to hide, not to be noticed, he should have scored around 90 at least, perhaps 100. There could be nothing less remarkable than being average. Instead, he'd twice achieved a false rating which must puzzle everybody.

Benny had never given any evidence of intelligence in the presence of Jennings, as he must have done with Marita and possibly with Susan Sonnenburg. Nevertheless, he had never managed to be dumb enough to fit a VTC 30 rating.

Why should anyone pretend to be a useless moron when he wasn't? Jennings could think of only one answer.

The police were polite but unimpressed. However, Sergeant Basch came to see Jennings. He was a bright young man who looked as if he had no intention of being a sergeant for long.

"I understand this man Rice has disappeared?" Basch said.

"He went to his apartment last night as usual, but didn't stay longer than five minutes. He hasn't been seen since."

"I didn't quite get what you meant about this test, Mr. Jennings. Why are you convinced that Rice faked it?"

"Like all personality tests," said Jennings, "this one is empirical. It's constantly being checked against facts, against other data and other results. And in the light of these it's modified. This has been going on for a long time. We can even invert the test, sort of, and instead of saying 'This man's VTC is so-and-so, therefore he ought to be capable of such-and-such,' we can say 'This man does such-and-such, therefore his VTC must be so-and-so.' Now Benny Rice hasn't exactly been running Musicosmos, but even what he's been doing here would need a rating of about 80."

"But the test shows 30."

"Yes."

"And therefore?"

"Therefore there's something funny about the test. Not the test itself or the way it was carried out, but the way Benny did it."

"I see. So you think—?"

"That he has his own reasons for pretending to be useless and of no account. The obvious possibility is that he committed some kind of crime."

Basch shook his head. "There are no unsolved crimes, Mr. Jennings. You know that. Any criminals around, we know about."

"That's if you established the crimes as crimes."

Basch was quite definite. "With transmitterless TV, crime has just about stopped," he said. "Not crimes of passion, of course. Not crime on impulse. But crime for profit, yes. There just isn't any profit."

"I don't think you've seen the significant point in this affair, sergeant. Benny is over a hundred. And if he faked the test he had yesterday, *he also faked the one he had seventy years ago.*"

"Maybe I'm just a dumb cop. I still don't get it."

"If Benny had to cover up seventy years ago, the crime, if any, must have occurred before that."

Basch snapped his fingers. "Of course. You mean it was so long ago we didn't have TTV?"

"Not exactly, but certainly before the present position was established—when everybody knows that crime doesn't pay, and doesn't try to buck the odds."

Basch grinned boyishly. "If this old guy has got away with something for more than seventy years, I say good luck to him."

"That's not the point, is it? Don't you want to find out the truth? I do. I can't understand how Benny got round those tests."

"Surely if you gave me the test, and I wanted a low rating for some reason, all I'd have to do would be answer most of the questions wrong?"

"No. It's not a straight yes-no ques-

tionnaire. The questions dovetail, and often in checking afterwards I have to take several answers together. Inconsistency shows up, and a deliberate attempt to fool the test would fail."

"But you've just said—"

"There's one way it could be done. I could do it, because I know the test—remember the answers."

"Is that possible?"

"Yes, because you don't so much remember a lot of individual, meaningless answers as a pattern. You know the kind of relationships you're supposed to be able to see, and the kind that are supposed to be beyond you. You know when to answer correctly, when to leave a blank space and when to write gibberish."

"That would take a pretty clever man, wouldn't it?"

"Yes."

There was something significant in his glance, and once more light dawned on Basch. "You mean this Rice character rates Rebirth, but can't collect because he's pretending to be a moron?"

"Exactly."

Basch became serious. "If you're right—if there was a crime—it must

be pretty serious. Nothing less than murder. Well, we'll soon find out."

"How?"

"Check back over Rice's life and see if anybody around him ever died. Then check all the deaths to make sure they were what they seemed to be."

"Can you establish that now?"

"Oh, sure."

"How?"

"In about a million ways. Suppose you shot me here and now. All the glass, metal, wood and plastic in the room would shiver and record the shot in their molecular structure. In ten years' time it could be established that a shot was fired, and the date could be fixed within a month. Likewise, the fumes would settle, dust would cover that, and even when the place was cleaned there'd be strata, just like in rock, and a careful examination might uncover the gas deposit. Might —wouldn't swear to that. Likewise, if I fell on the floor, that would make its record— 'Course, for every fact we want about the incident we want, we find a thousand we don't want about other incidents, other occasions—"

"You mean, once you have reason to look in a place, you find out everything that ever happened there?"

"Something like that. 'Course, we have to interpret what we find."

"And you're going to check back on Benny?"

"Well, that's what you wanted, isn't it?"

Jennings wasn't so sure now. He had nothing against old Benny, and there was something inhuman about a method of detection which could find out what had happened in a room years ago, even if all the people who had been present were dead—

Marita climbed the stairs to her flat slowly, wondering if she was a fool. She hadn't been at the Blue Moon since the night she met Benny there. But who was she fooling?

If you were an unsuccessful call-girl, it was easy to decide to be virtuous and turn your back on it. But, if you made a far better living at it than you could possibly make at anything else, it wasn't so easy.

On the door was a note from Mrs. Gersteiner:

Man calling himself J. S. has called twice.

J. S. was John Silver, the detective she had hired to find Benny Rice. Perhaps he had something to report. But she wasn't so sure now that she wanted to find Benny Rice. There was something decidedly peculiar about Benny.

She went into the bathroom and turned the tap. As she undressed she found it hard to resist the impulse to call Silver.

In the bath she soaped herself luxuriously. And suddenly she realized that she felt cleaner than she had for years.

As she realized once again what Benny meant to her she jumped out of the bath, scattering water in all directions like a dog shaking itself dry, and ran through to the phone.

The shiny cream phone slipped in her soapy hands, but she got Silver.

"Miss Herbert? I got news for you. I'll come over right away."

"Can't you tell me over the phone?"

"That depends. You want me to say it over the phone?"

She hesitated. "No. Come up here."

She dropped the phone in its cradle. Going back to the bathroom, she showered and dried herself.

When the buzzer went, she hadn't even begun to dress. Silver must be the world's fastest mover. She slipped a dress over her shoulders and pushed her feet into mules.

Silver came in looking her up and down appreciatively. "This job I like," he said.

"Spill it," said Marita briefly.

Letting his eyes play over her like a fire hose, Silver spoke absently but to the point. "Rice had his mind made up when he went to his apartment. That was obvious afterwards. If he was to shake me and everybody else, he'd have to go fast and far. So I assumed he'd gone straight to the airfield and took the first flight to anywhere."

"Benny wouldn't do anything as obvious as that."

"Wouldn't he? Lady, there are times when being subtle just gives people a chance to put a rope around your neck. The only answer to TTV is not being around when the cops start to get interested in you."

"The police aren't involved in this."

"No? Looked to me as if this guy Rice thought they might be. Otherwise why run like a scalded cat?"

"Did you have something to say?" Marita inquired.

"Sure. He took the first flight to anywhere. Florida, first stop Washington. I guessed he'd jump ship at Washington and had a man check. He did. He got on a flight for—wait for it—Florida."

"Huh?"

"Oh, he's no fool. If you're on a flight to Florida and jump ship, the last place anybody will expect you to go is Florida. Only if you're being tailed at the time, it's no good."

"So Benny Rice is in Florida?"

"He's living just outside Miami. I know where, but I haven't had anybody watch him."

"Why not?"

"He's not going anywhere. Either he was traced to Miami, in which case he can be traced from there, or he wasn't, and he'd be crazy to move."

Silver's aggressive assurance irritated Marita. He spoke and acted as if he had a private line to God. Nevertheless, she had to ask

"Why would he be crazy to move?"

"When the cops are looking for somebody, they check transport. Airfields, seaports, bus and train depots. Anybody who keeps running gets caught. You're smart, you find a hole and pull it in after you."

"Suppose Benny Rice thinks one step further than you?"

"Then he isn't in Miami. Say,

lady, what's an old guy like that to you?"

He had moved close as if merely for emphasis. Without appearing to move fast his hands were on her waist.

Marita shook herself impatiently, without managing to break his grasp. "Get out," she said dispassionately. "Behave yourself or get out."

"Who are you fooling, lady? Think I'd work for anybody without finding out about her?"

"I hired you to do a certain job. Apart from that, as far as I'm concerned, you're dead."

"I could come alive."

Marita broke loose and in the same movement clawed a tiny gun from a drawer in the table. "Out," she said. She had shown neither fear, interest nor disgust.

Silver could still grin. "You owe me a lot of money. You don't have to pay it."

"I prefer to."

His grin faded. "O.K. But what's wrong with me? Am I losing my fatal fascination?"

"I don't know. I never saw you with any."

Surprise and disbelief grew in his eyes. "You're in love with the old guy," he murmured. "Well, can you beat that?"

"What's that address?" Marita asked.

Marita waved again and started to wade toward him. Her silver swimsuit gleamed in the afternoon sun.

Benny watched her with the cool pleasure of his years. He could hardly be a hot lover at his time of life. He could take pleasure in the perfection of her proportions; however, he could have taken just as much pleasure in her beauty if she had been some other man's wife or mistress.

Water glistened on her golden skin as she dropped on the sand beside him. "Why don't you swim, Benny?"

"I think I've been peeped," he murmured.

She seized his arms and held tight as though by her own determination she could ward off the rest of the world. "They'll never find us," she said.

"On the contrary," said Benny mildly, "they're sure to find us if you stay with me, Marita. If you really want to help me, please leave me."

"No. Never."

Benny sighed. The certainty of defeat was on him, or he would have tried something. You could always get rid of a woman—couldn't you?

"Marita," he said gently, sympathetically. "I don't love you, you know."

"No," she said bitterly. "You're the only man I ever wanted to love me, so naturally you wouldn't."

"You're too young to think like that, Marita. I'm four times your age, and I think a lot more of the world than you do."

"Benny, why don't you tell me? Can't I help you? Can't I do anything?"

"Yes. You can go home. Then maybe I'll have a chance."

"Why do you talk like that? What harm am I doing?"

"That detective of yours knew I was in Miami. When they start looking for me they'll find him. They'll find out that you went to Miami. They'll look for you and find me."

"But we left Miami."

"Yes. But we're still so near that if they start searching in Miami and really mean to find us, they'll find us. And if we take a trip on a plane, ship, bus or train, they'll find us."

"Benny, what did you do? What'll it mean if you're caught?"

"Death," he said simply.

She caught her breath. She wanted to cry, but it had been so long since she cried she had forgotten how.

"I still love life," he said. "I'm old, but I'm sound. If they left me alone, I could have another twenty years, easily. Maybe thirty. I could live longer than the whole life of your life, Marita—if they let me. But I must be getting old, old in spirit, or I'd fight. I'd give you the slip and find myself another hole to hide in."

"You won't?" she said sharply. "Promise you won't?"

He shook his head. "I won't promise, Marita. I should go on fighting—and once I can collect what moral courage I have left, I will go on fighting. I'll beat them yet—"

A hand fell on his shoulder. Marita screamed, and through her scream a voice said: "Benjamin Rice, I charge you with the murder of Ralph Charles Coleman."

Benny looked up and smiled.

"Allow me to tell you, Mr. Rice," said the lawyer frostily, "that that attitude cuts no ice. I have been retained to defend you. I shall do so to the best of my ability, whatever insults you heap on me."

"I expect you will," said Benny, "since you're prepared to accept in payment for your services the earnings of a prostitute."

Kensel breathed deeply. "Considering what Miss Herbert is doing for you," he said, "that remark reveals the lowest possible moral character."

"It reveals the truth."

Kensel swallowed. "Rice, can't you realize that girl . . . that girl *loves* you—" He had managed to say it, though the effort made his face pink with embarrassment.

"Apparently I'm not to be allowed to forget it," Benny said.

He was fighting now. It was too late to run; he had nothing but his wits left. First, he had to try to get rid of this man.

"Marita Herbert is one of the finest women I know," said Kensel. "It passes my comprehension how she could be so deceived in a man like you. But since she feels as she does, I am prepared to try to believe there is some good in you."

"That's big of you," said Benny. "I don't want you, Kensel. I'm going to plead guilty."

"You're not allowed to plead guilty."

"I'm going to conduct my own defense, then."

"That's your privilege."

"So why don't you get out?"

"For Miss Herbert's sake I am going to do my best for you. I hope you go to the gas chamber, but I am going to do my best to see that you don't."

He was, too. Benny was silent, planning a new tack. This one was no good. Marita had done a good job on Kensel. If she hadn't won him over to Benny's side, she'd won him over to hers.

"Since I was goaded into speaking plainly just now," said the lawyer, his pink cheeks even pinker, "I may as well say one thing more. Your crime in murdering a man like Ralph Charles Coleman twenty years ago—as I have no doubt you did—is such a particularly beastly one that I wish I were prosecuting you. You knew what you were doing. For a mere three thousand dollars, you silenced one of the great voices of the century."

"He was an old bore," said Benny reflectively.

"The greatest authority on malaria in the world . . . the man responsible for more saving of life than all—"

"They'll never convict me, and you know it," said Benny.

"On the contrary, there's a better than even chance that they will. Although the police were quite satisfied at the time that Coleman shot himself, the recent examination of the room shows quite clearly that he fell and lay still and was shot *afterwards.* There can't be any doubt about that, and you can't explain it."

"Why should I explain it?"

"Because, if you don't, you'll be convicted. How can a man commit suicide if he falls first and *then* gets shot?"

Benny shrugged. "He got up, shot himself and fell down again."

"No. The evidence in Coleman's study, which hasn't been used since, is absolutely clear. There was only one fall. And afterwards he was shot. He was shot as he lay on the ground. He couldn't have done that himself."

No, he couldn't, Benny thought. He didn't. I did it. Funny how they haven't found out a dozen other queer and significant things about that day twenty years ago, yet they're absolutely sure of that.

These marvelous police methods couldn't be so marvelous after all. Twenty years ago the police had been convinced of one lie. Now they were convinced of another. In another twenty years, maybe they'd find out the truth.

The jailer spoke from the cell door. "Miss Herbert to see you, Rice."

"You can go," said Benny to the lawyer. He couldn't bring himself to be cruel to Marita, and if Kensel saw them together he might see through Benny's act.

"She wants me to stay. She wants to talk to you with me present."

Marita came in like a ray of sunlight. Another defense broke down in Benny. Let it go. He wasn't getting anywhere with his efforts to get rid of Kensel, anyway.

Benny took her hands and smiled.

Beside him, Kensel choked at the sudden change in him.

"Three-quarters of the press is on our side," Marita said eagerly. "They say you're over a hundred and harmless. There's no suggestion that you committed any crime in the last twenty years. They say— Benny, I still can't believe it. I don't believe you ever killed anybody. You couldn't."

"But I did," said Benny gently. "Marita, I'm glad you're here. I've been trying to disgust Kensel so that he'll drop the case. But he won't. So let's try something else. Marita, you want what I want, don't you?"

"Yes."

"I want to die."

"No!" Marita whispered, while Kensel stared dazedly at this old leopard who had suddenly changed his spots. He was kind and gentle with Marita.

"You can't," Marita said with more conviction. "You don't. You love life. You still love life."

"Yes," Benny admitted, "if I'm allowed to live it my own way, in freedom. Marita, you know I'm not going to be acquitted. Once the police started tracing the history of Benny Rice, I was finished. They traced my life to the time I became caretaker to Coleman, and naturally, just in passing, they had another look into his suicide. Twenty years ago Coleman wrote letters and made phone calls that convinced people he was going to commit suicide. And while I was around I was able to direct the investigations so that the official conclusions came out the way I wanted them. But what can you do when the police can go back to the scene of the crime and from the vibrations damped by wood, metal and textiles twenty years ago, reconstruct what happened then?"

"*Some* of what happened twenty years before," said Kensel.

There was such significance in his tone that Marita stared at him, puzzled, and Benny with sudden foreboding.

"I had only seen you acting like a first-degree heel, or I'd have guessed long ago," the lawyer said. "You're Coleman, of course."

Benny had seen it coming and decided not to deny it. "Yes. And *now* do you see why I want to die? I'm Coleman. A great man, you said, Kensel. But murder's the same whether a useless old moron like Benny Rice kills Coleman or Coleman kills the useless old moron. It's the same crime — homicide. I've had twenty years as Benny Rice, and I'd do anything for twenty more. But if I'm to die, or worse still, go to prison, I'd rather stay Benny Rice."

Marita was frowning. "It's nothing to me who you are. I knew you as Benny Rice, and I don't care which you are."

"I know you don't, Marita. But I do. Kensel, will you get me the death penalty—knowing that's what I want?"

"I'd like to get you Rebirth," Kensel said quietly.

Marita jumped convulsively.

Benny laughed. "No, thank you.

To get me Rebirth you'd have to get me off first, by showing there wasn't any murder twenty years ago. Then you'd have to show I was Coleman, not Rice. Then you'd have to—"

"Just a minute," said Kensel sharply. "I've just thought of something. If we can show you're Coleman, not Rice, the motive for murder disappears. You didn't kill Rice for your own three thousand dollars—a tiny fraction of your bank balance. You've got to show you're Coleman."

"On the contrary," Benny said, "I've got to stay Rice. Rice was a moron, by any reckoning. The charge against him can't be anything more than a brutal, simple crime. The case against Coleman—against me—is that I formulated a complicated plot, writing letters and phoning people falsifying all the records relating to myself, with the object of having the dead body of Rice taken for mine. It would also follow, since he was exactly the same age as me, and since I employed him weeks before, and since his face was changed to mine and mine to his, that there was a long-standing murder plot to kill a poor old derelict and substitute his body for mine, so that I could disappear."

Marita was looking lost and unhappy. In the last few minutes, somehow, she had lost Benny. The strange love affair between her and Benny had been unequal in many ways, but it had seemed to balance. The affair between her and Ralph Charles Coleman, who might have been a great man but who sounded an old

bore, as Benny said, didn't balance at all.

Kensel was looking unhappy too. "Well, why *did* you do it?" he demanded.

Benny considered. "For two pins I'd tell you," he said. But Kensel knew he was lying. Kensel knew he would never tell anybody.

Kensel was wrong. There came a moment in Benny's trial when the possibility that he was Coleman and not Benny Rice was mentioned. There came a moment when it looked as if he might get life imprisonment instead of death.

There came the moment when the judge asked if Benny had anything to say before he passed sentence.

The verdict was guilty; the sentence could only be imprisonment or death.

"Yes," said Benny. "Yes, I have."

There was a murmur in court. Throughout the trial he had remained as inarticulate as a man with his VTC rating might be expected to be. Now he spoke strongly and clearly and looked like his own son.

"The possibility that I might be Coleman and not Rice has been mentioned," Benny said. "Nothing came of it, because it was so manifestly ridiculous. Is it ridiculous now?"

The murmur in court grew to a roar. Everyone knew Rice's I.Q. and VTC. This wasn't Benny Rice speaking.

"I am going to tell you," said Ralph Charles Coleman, "why I killed Benny Rice.

"I did not want Rebirth.

"I wanted to live my life to the full and die when it was over. When a man goes for Rebirth, does he survive? No. He remembers nothing of his previous life, of his own personal history. He becomes another person.

"I didn't want to become another person. I wanted to live until I died. Many people are like me, feel as I do, but they are silenced by pride in being thought worthy of Rebirth, and fear of the eternal night. Rebirth is a postponement. Even if the thing they become remembers nothing of the thing they were, at least there is no ending—yet. They surrender their lives at seventy, at eighty, instead of risking death at any moment if they chose to try to live longer.

"At eighty I was subject to increasing pressure to accept Rebirth. I didn't want it. I wanted the twenty years I've had since then, the twenty or thirty more I could have. But Ralph Charles Coleman had no choice. He was too important, too valuable. The world couldn't afford to lose his valuable brain. The pressure was approaching a point where it would become compulsion.

"I had to escape. I was selfish. I didn't care about the value to the world of Ralph Charles Coleman. I was concerned about my value to myself. I wanted to go on being myself.

"And the only way I could do so was to cease being myself.

"My plans worked well, as you'll

agree. If only people had left poor harmless old Benny Rice alone, they'd have worked perfectly. Knowing I had no natural ability in music I went to Musicosmos as a caretaker. Completely lacking in talent, how could I give myself away? But unfortunately one woman liked me, another loved me. And things happened, and it was discovered that twenty years ago the man who died wasn't the man who fired the shot."

He looked straight at the judge. There was complete silence in court.

And at that moment, of all moments, a picture of what had happened twenty years ago flashed through his mind.

Old Benny had died, and he had shot him, but he hadn't killed him. It was after Benny died of a seizure that the brilliant Ralph Charles Coleman conceived his fantastically complicated scheme to steal his own life from the Rebirth Institute. Only a doctor could have done it. Many things had had to be done—many things had been done. But the only part of it which had been found out, even now, was that the fall had preceded the shot.

Coleman could be acquitted. Even now he could be acquitted. He could have a fuller investigation made, and this time, not merely looking for evidence that a suicide was murder, the investigators would find that there had been neither, and that a dead man had been shot.

But that wouldn't be acquittal. That way led to Rebirth for Coleman.

"I have made this statement," he said, "because imprisonment would be worse to me than Rebirth. But I must suffer imprisonment, Rebirth or death. Society would not let me go free, to die my own death. I killed a man to escape Rebirth. The crime still keeps me safe from it. So since it must be imprisonment or death, may I ask for mercy?

"May I ask for death?"

There was silence for a long time. And then the judge granted his wish.

The wonder didn't quite last nine days. After the execution, the legal question whether Coleman could be convicted for the murder of Rice after being convicted, as Rice, of the murder of Coleman, became academic.

It was decided that the verdict was wrong.

And after that everybody wanted to forget about it.

Marita was married within three weeks to Kensel, much to everybody's surprise, including their own. He was a little old for her; but then, he was sixty years younger than Benny.

Everyone still thought of him as Benny. Indeed, one reason why the hubbub soon died was the nasty taste which was left behind by the case. Some felt that even a man like Ralph Charles Coleman should be allowed to live his own life if he wanted to, and not have Rebirth thrust upon him. Some felt a man shouldn't have to kill to avoid Rebirth. Nearly everybody, sympathetic or unsympathetic, felt that the whole business

undermined the name and fame of a great man.

It was much better to think of him as Benny Rice.

At the Rebirth Institute Dr. Martin looked at the sleeping boy and recalled with wonder the shambling old idiot who had certainly had him fooled. Must have been a pretty good actor, the old boy.

Betty Rogers came and stood at his shoulder.

"He's new, isn't he?" she said—she could speak now. Also she had begun to care how she looked, and in a white nylon dress, she looked all right.

"Yes."

"What's his name?"

"Dick Herman." Or Benny Rice, or Ralph Charles Coleman, Martin thought. Poor old Benny, who didn't want Rebirth but couldn't escape it.

"Why has he been asleep so much longer than everybody else?"

"We weren't sure he'd be allowed to stay. You see, Betty, we wanted him here, as we want all of you, but if people have done certain things, they're not allowed to stay. Dick was brought here, because we wanted him so much, and because somebody thought, being such a nice boy, he couldn't really have done what he was supposed to have done, after all."

And *that* was quite a nice allegory to explain how old Benny had been brought from the gas chamber, unconscious but certainly not dead, and put through the Rebirth process still thinking that he'd died in the gas chamber—if you could put it like that.

"How could they think he had done something if he hadn't?" Betty asked.

The questions of a Reborn child were quite as difficult to answer as those of an ordinary one. But Martin accepted the challenge.

"He wanted everybody to think he had done it, because he didn't want to stay here."

The police had eventually decided that after Benny Rice died of natural causes, Coleman had evolved a brilliant scheme which won him twenty more years of life and nearly got him executed at the end of it. But there were red faces all round at the way Benny Rice had not merely been arrested but had been convicted of a murder when there hadn't really been a murder at all, and if there had been it would have been the other way round.

Martin wondered daringly whether the powers that be had simply decided that there hadn't been a murder because a man like Coleman couldn't be allowed to go to the gas chamber merely for putting a creature like Benny Rice out of its presumed misery. But such thoughts were dangerous.

"Why didn't he want to stay here?" Betty asked.

"He didn't know what it was like," said Martin patiently, "or he wouldn't have minded."

"How do you know? Didn't I want to stay here either?"

"You didn't mind coming here. Look, Dick's wakening up."

Betty bent over him like a child mother. "You'll like it here, Dick," she said soothingly.

Under his breath, Martin bet he would. He wouldn't mind marrying Betty Rogers himself in a year or two.

But then, the Rebirth Institute didn't actually fix marriages. Marriages were made in heaven.

With material supplied by the Rebirth Institute, of course.

"You can't talk yet," said Betty, "but we'll teach you to talk. Oh, Dr. Martin, look what a nice smile he has. I think I'm going to like him."

In heaven, something was made.

THE END

THE ANALYTICAL LABORATORY

It's time, I think, to repeat the every-so-often explanation of how the An Lab works, for the benefit—and voting encouragement—of new readers.

Please send in votes—letter or postcard—giving your rating of the stories in the issue in order of preference. At the office, the vote is recorded, a vote for first place gives the story a 1; second place gives it 2, third is 3, et cetera When it comes time to make up the An Lab column, the points each story collected are totaled, and divided by the number of votes. Low score wins, of course.

Then the author who won first place receives a reader-determined bonus of 1¢ a word; 2nd place gets ½¢ a word bonus. On a novel, you readers can hand an author—at no expense to yourselves!—a nice bonus of $600 to $800. In the case of "Sweet Little Old Lady," our two-headed author, Mark Phillips, shared, between his two heads, some $400, thanks to you readers.

Under these circumstances, your votes are most definitely of interest to me, and to the authors. They wait your golden words of comment. And you can do a very real favor to the author that does you the service of telling you a good yarn. Give him a vote!

December 1959 Issue.

PLACE	STORY	AUTHOR	POINTS
1.	The Destroyers	Randall Garrett	2.23
2.	The Best Made Plans (Conclusion)	Everett B. Cole	2.53
3.	The Big Fix	George O. Smith	3.00
4.	Mating Problem	Christopher Anvil	3.38
5.	Tell the Truth	E. C. Tubb	3.84

THE EDITOR.

IN CASE OF FIRE

There are times when a broken tool is better than a sound one, or a twisted personality more useful than a whole one. For instance, a whole beer bottle isn't half the weapon that half a beer bottle is . . .

By RANDALL GARRETT

Illustrated by Martinez

IN HIS office apartment, on the top floor of the Terran Embassy Building in Occeq City, Bertrand Malloy leafed casually through the dossiers of the four new men who had been assigned to him. They were typical of the kind of men who were sent to him, he thought. Which meant, as usual, that they were atypical. Every man in the Diplomatic Corps who developed a twitch or a quirk was shipped to Saarkkad IV to work under Bertrand Malloy, Permanent Terran Ambassador to His Utter Munificence, the Occeq of Saarkkad.

Take this first one, for instance. Malloy ran his finger down the columns of complex symbolism that showed the complete psychological analysis of the man. Psychopathic paranoia. The man wasn't technically insane; he could be as lucid as the next man most of the time. But he was morbidly suspicious that every man's hand was turned against him. He trusted no one, and was perpetually on his guard against imaginary plots and persecutions.

Number two suffered from some sort of emotional block that left him continually on the horns of one dilemma or another. He was psychologically incapable of making a decision if he were faced with two or more possible alternatives of any major importance.

Number three . . .

Malloy sighed and pushed the dossiers away from him. No two men were alike, and yet there sometimes

seemed to be an eternal sameness about all men. He considered himself an individual, for instance, but wasn't the basic similarity there, after all?

He was—how old? He glanced at the Earth calendar dial that was automatically correlated with the Saarkkadic calendar just above it. Fifty-nine next week. Fifty-nine years old. And what did he have to show for it besides flabby muscles, sagging skin, a wrinkled face, and gray hair?

Well, he had an excellent record in the Corps, if nothing else. One of the top men in his field. And he had his memories of Diane, dead these ten years, but still beautiful and alive in his recollections. And—he grinned softly to himself—he had Saarkkad.

He glanced up at the ceiling, and mentally allowed his gaze to penetrate it to the blue sky beyond it.

Out there was the terrible emptiness of interstellar space—a great, yawning, infinite chasm capable of swallowing men, ships, planets, suns, and whole galaxies without filling its insatiable void.

Malloy closed his eyes. Somewhere out there, a war was raging. He didn't even like to think of that, but it was necessary to keep it in mind. Somewhere out there, the ships of Earth were ranged against the ships of the alien Karna in the most important war that Mankind had yet fought.

And, Malloy knew, his own position was not unimportant in that war. He was not in the battle line, nor even in the major production line, but it was necessary to keep the drug supply lines flowing from Saarkkad, and that meant keeping on good terms with the Saarkkadic government.

The Saarkkada themselves were humanoid in physical form—if one allowed the term to cover a wide range of differences—but their minds just didn't function along the same lines.

For nine years, Bertrand Malloy had been Ambassador to Saarkkad, and for nine years, no Saarkkada had ever seen him. To have shown himself to one of them would have meant instant loss of prestige.

To their way of thinking, an important official was aloof. The greater his importance, the greater must be his isolation. The Occeq of Saarkkad himself was never seen except by a handful of picked nobles, who, themselves, were never seen except by their underlings. It was a long, roundabout way of doing business, but it was the only way Saarkkad would do any business at all. To violate the rigid social setup of Saarkkad would mean the instant closing off of the supply of biochemical products that the Saarkkadic laboratories produced from native plants and animals—products that were vitally necessary to Earth's war, and which could be duplicated nowhere else in the known universe.

It was Bertrand Malloy's job to keep the production output high and to keep the materiel flowing towards Earth and her allies and outposts.

The job would have been a snap cinch in the right circumstances; the Saarkkada weren't difficult to get along with. A staff of top-grade men

could have handled them without half trying.

But Malloy didn't have top-grade men. They couldn't be spared from work that required their total capacity. It's inefficient to waste a man on a job that he can do without half trying where there are more important jobs that will tax his full output.

So Malloy was stuck with the culls. Not the worst ones, of course; there were places in the galaxy that were less important than Saarkkad to the war effort. Malloy knew that, no matter what was wrong with a man, as long as he had the mental ability to dress himself and get himself to work, useful work could be found for him.

Physical handicaps weren't at all difficult to deal with. A blind man can work very well in the total darkness of an infrared-film darkroom. Partial or total losses of limbs can be compensated for in one way or another.

The mental disabilities were harder to deal with, but not totally impossible. On a world without liquor, a dipsomaniac could be channeled easily enough; and he'd better not try fermenting his own on Saarkkad unless he brought his own yeast—which was impossible, in view of the sterilization regulations.

But Malloy didn't like to stop at merely thwarting mental quirks; he liked to find places where they were *useful.*

The phone chimed. Malloy flipped t on with a practiced hand.

"Malloy here."

"Mr. Malloy?" said a careful voice. "A special communication for you has been teletyped in from Earth. Shall I bring it in?"

"Bring it in, Miss Drayson."

Miss Drayson was a case in point. She was uncommunicative. She liked to gather in information, but she found it difficult to give it up once it was in her possession.

Malloy had made her his private secretaryy. Nothing—but *nothing*—got out of Malloy's office without his direct order. It had taken Malloy a long time to get it into Miss Drayson's head that it was perfectly all right—even desirable—for her to keep secrets from everyone except Malloy.

She came in through the door, a rather handsome woman in her middle thirties, clutching a sheaf of papers in her right hand as though someone might at any instant snatch it from her before she could turn it over to Malloy.

She laid them carefully on the desk. "If anything else comes in, I'll let you know immediately, sir," she said. "Will there be anything else?"

Malloy let her stand there while he picked up the communique. She wanted to know what his reaction was going to be; it didn't matter because no one would ever find out from her what he had done unless she was ordered to tell someone.

He read the first paragraph, and his eyes widened involuntarily.

"Armistice," he said in a low whisper. "There's a chance that the war may be over."

"Yes, sir," said Miss Drayson in a hushed voice.

Malloy read the whole thing through, fighting to keep his emotions in check. Miss Drayson stood there calmly, her face a mask; her emotions were a secret.

Finally, Malloy looked up. "I'll let you know as soon as I reach a decision, Miss Drayson. I think I hardly need say that no news of this is to leave this office."

"Of course not, sir."

Malloy watched her go out the door without actually seeing her. The war was over—at least for a while. He looked down at the papers again.

The Karna, slowly being beaten back on every front, were suing for peace. They wanted an armistice conference—immediately.

Earth was willing. Interstellar war is too costly to allow it to continue any longer than necessary, and this one had been going on for more than thirteen years now. Peace was necessary. But not peace at any price.

The trouble was that the Karna had a reputation for losing wars and winning at the peace table. They were clever, persuasive talkers. They could twist a disadvantage to an advantage, and make their own strengths look like weaknesses. If they won the armistice, they'd be able to retrench and rearm, and the war would break out again within a few years.

Now—at this point in time—they could be beaten. They could be forced to allow supervision of the production potential, forced to disarm, rendered impotent. But if the armistice went to their own advantage . . .

Already, they had taken the offensive in the matter of the peace talks. They had sent a full delegation to Saarkkad V, the next planet out from the Saarkkad sun, a chilly world inhabited only by low-intelligence animals. The Karna considered this to be fully neutral territory, and Earth couldn't argue the point very well. In addition, they demanded that the conference begin in three days, Terrestrial time.

The trouble was that interstellar communication beams travel a devil of a lot faster than ships. It would take more than a week for the Earth government to get a vessel to Saarkkad V. Earth had been caught unprepared for an armistice. They objected.

The Karna pointed out that the Saarkkad sun was just as far from Karn as it was from Earth, that it was only a few million miles from a planet which was allied with Earth, and that it was unfair for Earth to take so much time in preparing for an armistice. Why hadn't Earth been prepared? Did they intend to fight to the utter destruction of Karn?

It wouldn't have been a problem at all if Earth and Karn had fostered the only two intelligent races in the galaxy. The sort of grandstanding the Karna were putting on had to be played to an audience. But there were other intelligent races throughout the galaxy, most of whom had remained as neutral as possible during the Earth-Karn war. They had no inten-

tion of sticking their figurative noses into a battle between the two most powerful races in the galaxy.

But whoever won the armistice would find that some of the now-neutral races would come in on their side if war broke out again. If the Karna played their cards right, their side would be strong enough next time to win.

So Earth had to get a delegation to meet with the Karna representatives within the three-day limit or lose what might be a vital point in the negotiations.

And that was where Bertrand Malloy came in.

He had been appointed Minister and Plenipotentiary Extraordinary to the Earth-Karn peace conference.

He looked up at the ceiling again. "What *can* I do?" he said softly.

On the second day after the arrival of the communique, Malloy made his decision. He flipped on his intercom and said: "Miss Drayson, get hold of James Nordon and Kylen Branyek. I want to see them both immediately. Send Nordon in first, and tell Branyek to wait."

"Yes, sir."

"And keep the recorder on. You can file the tape later."

"Yes, sir."

Malloy knew the woman would listen in on the intercom anyway, and it was better to give her permission to do so.

James Nordon was tall, broad-shouldered, and thirty-eight. His hair was graying at the temples, and his handsome face looked cool and efficient.

Malloy waved him to a seat.

"Nordon, I have a job for you. It's probably one of the most important jobs you'll ever have in your life. It can mean big things for you—promotion and prestige if you do it well."

Nordon nodded slowly. "Yes, sir."

Malloy explained the problem of the Karna peace talks.

"We need a man who can outthink them," Malloy finished, "and judging from your record, I think you're that man. It involves risk, of course. If you make the wrong decisions, your name will be mud back on Earth. But I don't think there's much chance of that, really. Do you want to handle small-time operations all your life? Of course not.

"You'll be leaving within an hour for Saarkkad V."

Nordon nodded again. "Yes, sir; certainly. Am I to go alone?"

"No," said Malloy, "I'm sending an assistant with you—a man named Kylen Braynek. Ever heard of him?"

Nordon shook his head. "Not that I recall, Mr. Malloy. Should I have?"

"Not necessarily. He's a pretty shrewd operator, though. He knows a lot about interstellar law, and he's capable of spotting a trap a mile away. You'll be in charge, of course, but I want you to pay special attention to his advice."

"I will, sir," Nordon said gratefully. "A man like that can be useful."

"Right. Now, you go into the anteroom over there. I've prepared a sum-

mary of the situation, and you'll have to study it and get it into your head before the ship leaves. That isn't much time, but it's the Karna who are doing the pushing, not us."

As soon as Nordon had left, Malloy said softly: "Send in Braynek, Miss Drayson."

Kylen Braynek was a smallish man with mouse-brown hair that lay flat against his skull, and hard, penetrating, dark eyes that were shadowed by heavy, protruding brows. Malloy asked him to sit down.

Again Malloy went through the explanation of the peace conference.

"Naturally, they'll be trying to trick you every step of the way," Malloy went on. "They're shrewd and underhanded; we'll simply have to be more shrewd and more underhanded. Nordon's job is to sit quietly and evaluate the data; yours will be to find the loopholes they're laying out for themselves and plug them. Don't antagonize them, but don't baby them, either. If you see anything underhanded going on, let Nordon know immediately."

They won't get anything by me," Mr. Malloy.

By the time the ship from Earth got there, the peace conference had been going on for four days. Bertrand Malloy had full reports on the whole parley, as relayed to him through the ship that had taken Nordon and Braynek to Saarkkad V.

Secretary of State Blendwell stopped off at Saarkkad IV before going on to V to take charge of the conference. He was a tallish, lean man with a few strands of gray hair on the top of his otherwise bald scalp, and he wore a hearty, professional smile that didn't quite make it to his calculating eyes.

He took Malloy's hand and shook it warmly. "How are you, Mr. Ambassador?"

"Fine, Mr. Secretary. How's everything on Earth?"

"Tense. They're waiting to see what is going to happen on Five. So am I, for that matter." His eyes were curious. "You decided not to go yourself, eh?"

"I thought it better not to. I sent a good team, instead. Would you like to see the reports?"

"I certainly would."

Malloy handed them to the secretary, and as he read, Malloy watched him. Blendwell was a political appointee—a good man, Malloy had to admit, but he didn't know all the ins and outs of the Diplomatic Corps.

When Blendwell looked up from the reports at last, he said: "Amazing! They've held off the Karna at every point! They've beaten them back! They've managed to cope with and outdo the finest team of negotiators the Karna could send."

"I thought they would," said Malloy, trying to appear modest.

The secretary's eyes narrowed. "I've heard of the work you've been doing here with . . . ah . . . sick men. Is this one of your . . . ah . . . successes?"

Malloy nodded. "I think so. The Karna put us in a dilemma, so I

threw a dilemma right back at them."

"How do you mean?"

"Nordon had a mental block against making decisions. If he took a girl out on a date, he'd have trouble making up his mind whether to kiss her or not until she made up his mind for him, one way or the other. He's that kind of guy. Until he's presented with one, single, clear decision which admits of no alternatives, he can't move at all.

"As you can see, the Karna tried to give us several choices on each point, and they were all rigged. Until they backed down to a single point and proved that it *wasn't* rigged, Nordon couldn't possibly make up his mind. I drummed into him how important this was, and the more importance there is attached to his decisions, the more incapable he becomes of making them."

The Secretary nodded slowly. "What about Braynek?"

"Paranoid," said Malloy. "He thinks everyone is plotting against him. In this case, that's all to the good because the Karna *are* plotting against him. No matter what they put forth, Braynek is convinced that there's a trap in it somewhere, and he digs to find out what the trap is. Even if there isn't a trap, the Karna can't satisfy Braynek, because he's convinced that there *has* to be—somewhere. As a result, all his advice to Nordon, and all his questioning on the wildest possibilities, just serves to keep Nordon from getting unconfused.

"These two men are honestly doing their best to win at the peace conference, and they've got the Karna reeling. The Karna can see that we're not trying to stall; our men are actually working at trying to reach a decision. But what the Karna don't see is that those men, as a team, are unbeatable because, in this situation, they're psychologically incapable of losing."

Again the Secretary of State nodded his approval, but there was still a question in his mind. "Since you know all that, couldn't you have handled it yourself?"

"Maybe, but I doubt it. They might have gotten around me someway by sneaking up on a blind spot. Nordon and Braynek have blind spots, but they're covered with armor. No, I'm glad I couldn't go; it's better this way."

The Secretary of State raised an eyebrow. "*Couldn't* go, Mr. Ambassador?"

Malloy looked at him. "Didn't you know? I wondered why you appointed me, in the first place. No, I couldn't go. The reason why I'm here, cooped up in this office, hiding from the Saarkkada the way a good Saarkkadic bigshot should, is because I *like* it that way. I suffer from agoraphobia and xenophobia.

"I have to be drugged to be put on a spaceship because I can't take all that empty space, even if I'm protected from it by a steel shell." A look of revulsion came over his face. "And I can't *stand* aliens!"

THE END

SHOTGUN

By CHRISTOPHER ANVIL

And in this case, is was the extremely reluctant bridegroom who thoughtfully supplied the atomic-powered shotgun...

Illustrated by Summers

STIL Bek, Sector Controller of the Planetary Occupation Service, could tell a real mess when he saw one. With the impressions of jangling confusion still fresh in his mind, he clasped hands in the inner office with Kife, the Initial Penetration Commander. Stil noted Kife's feverish grip and glittering eye as Kife turned to point to a blond wood cabinet with a twenty-eight inch screen.

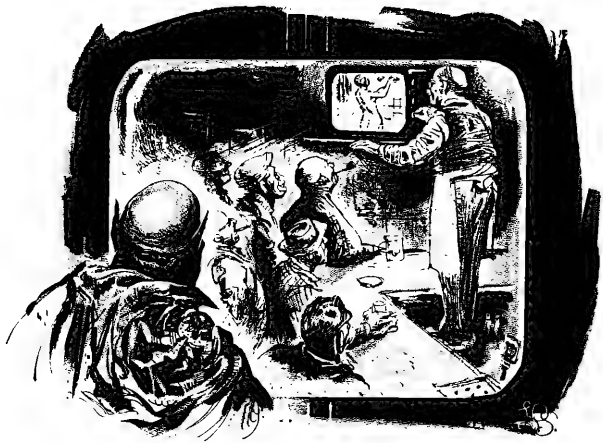
"With that," said Kife, "I will throw them into total chaos. When I get through, there won't be a sound mind or a stable government left on the planet. Watch."

Kife twisted a knob on the side of the cabinet. On the screen, floors and lighted rooms slid past, as if they looked into a building with one outside wall removed. Amidst a multitude of innocent scenes, Kife paused to show violent arguments, wild drinking parties, a group of people trading malicious gossip, and various couples who looked suspiciously as if they did not belong together.

Kife grinned. "Lies, backbiting, adultery, betrayal. Once a viewer sees these things on the screen, he'll watch them instead of anything else. And it's all *real*. The poison this device will spread will ruin the planet."

Stil felt his back hair prickle. "This is a scientifically advanced planet. Kife. Isn't this a dangerous device to release here? There isn't a world in the Galactic Combine where we'd dare to do this."

Kife didn't seem to hear him. "I've got the distribution problem whipped, too." He spread out a big map that showed the planet's western hemisphere surrounded by ocean, and



.WEDDING

ringed by selected parts of other continents. Large gray areas dotted in red and green were scattered over the map.

"The gray areas," said Kife, "are population centers. The green dots represent legitimate merchants. If the local governments block those, I've got black-market contacts set up - those are the red dots."

Stil felt the edge of the map with a finger to see if by any chance it wasn't all unfolded. "What about the rest of the planet?"

"I'll hit that later. First, I'll throw this western half into chaos and create a power vacuum. When the other bloc on the planet moves in to take over, there'll be confusion. Then I'll slip large numbers of the device into their territory. Since they work even more by secrecy and deceit, it will wreck them, too." He snapped his fingers. "Oh, yes, there's something else I wanted to show you."

He punched a button on his desk. The door flew open, and a quivering subordinate popped in. Kife scribbled on a pad, ripped off the top sheet, and thrust it out to the subordinate, who scurried out and was back shortly with a folded bundle of paper covered with printing.

"This," said Kife, "is what the locals call a 'newspaper'." He snapped it open to a big ad headed:

ALL DOORS ARE OPEN
—WHEN YOU OWN AN RTV!

Beneath this was a picture of a family gathered reverently about an oversized screen that showed a circle of men and women in formal clothes.

Stil, who had learned the language in a hurry as his ship hurtled him through space to this planet, understood only snatches of the main body of the ad. But he could read enough to get the idea:

". . . What will ordinary TV *do* for you? . . . Just the same old shows, endlessly repeated . . . But suppose you could touch the magic knob and go anywhere . . . view real life anywhere in the world, in all its surging passion and variety . . . Uncensored! . . . Now, by a miracle of modern science . . . the dream of the ages comes true . . . And better yet, once you own an RTV, it shields you so no outsider can snoop into *your* home . . . Free from prying . . . exercise your healthy urge for reality, unafraid . . . Low, low down payment . . . See us soon."

Stil took a deep breath. "How soon are you planning to distribute the device?"

A look of proud achievement appeared on Kife's face. When he spoke, the words rang in Stil's ears like a sentence of doom.

"I've done it," said Kife.

Stil got some more details from Kife, then left the room in a kind of stupor. A nervous orderly guided Stil to a windowless private room and bath. Stil locked the door and glanced around. He was realizing, as he had in tight spots before, what a fortunate thing it was that the Galactic Combine had means of fast and secret communication. It might be too late for him to do anything, but he could warn others, so the situation might yet be gotten under control. Stil snapped off the room light, and lay down on the bed. He relaxed, and gradually quieted his thoughts. As his mind became calm, the faint hiss of the implanted transceiver grew louder, till it was like the whistle of steam from a tea kettle in a quiet room. Within the whistle, he could hear faint variations, which gradually became more distinct, and then formed words:

"Hello? Stil? . . . Come in, please . . ."

Stil formed a reply in his mind, and heard the words as clearly as if he spoke. "Right here, Dinal."

"Thank heaven. Have you reached 26JB3?—'Earth', as its inhabitants call it?"

"I'm there right now."

"Is it as bad as we thought?"

"Worse. Kife has actually put the sets on the market. Better than eight hundred were sold before I got here, with heavy advance publicity. There are hundreds of thousands more in stores and warehouses scattered over half the planet. We can't squash this now."

There was a silence, then Dinal said, "We notified the Chief."

"What happened?"

"The worst. He didn't explode. He just sent out for the whole file. Meanwhile, he's had no lunch, and no dinner. He's just working through his files. About six hours from now, he'll have the whole picture. He'll also be in a foul mood. Then the heads will really fly."

Stil grunted.

Dinal said, "What are you planning to do?"

"I'm still worn out from that conference on Tikra IV. I got here by ultrafast spacer, under maximum boost, and my control ship hasn't caught up yet. Until it does, I'm going to catch up on sleep."

"You must have iron nerves. Well, good luck."

"Thanks. Good luck to you."

The words faded into an unvarying whistle that died away to silence as Stil lay back, thinking.

In his mind's eye, he could see for a moment the great sweep of the Galactic Combine, holding its thousands of wide-flung planets in unified control. Stil saw his own sector as part of a huge pattern that constantly expanded as scout ships spotted new planets, and penetration teams moved in to study the local life forms, spot their weak points, and subtly introduce a new factor that would set the native populace at each other's throats and make the way easy for later exploitation and integration into the Combine.

Each planet, Stil thought, offered its own challenge. But planets of the type of this "Earth" were particularly tricky. Already split into hostile, scientifically alert factions, they were accustomed to stress, strain, and upheaval, as regular conditions of life. This meant that the disrupting factor had to be selected with care, and subtly introduced at just the right place and time. Otherwise, the planet might erupt into an outburst that would all but blow it to bits, thus losing it for the Combine. Or, the suspicion of outside interference might actually unify the warring factions overnight. All sorts of pitfalls lay in the path of the penetration teams on this type of planet. The strain on the penetration commander was particularly intense. Occasionally, a commander broke, lost contact with reality, slanted his reports according to his private delusions, and was not found out till the catastrophe happened. Then there was real trouble. Just as there was right now.

Stil decided there was no use thinking of it. He got up, washed, lay down again, and soon fell into an exhausted sleep.

Stil woke very early the next morning, the whistle loud in his head. As he held his attention on it, the voice grew clear, and he realized it was not Dinal this time, but Jad, his emergency controller. Jad's characteristic sourness came through clearly.

"Come in," said Jad. "Come in, Stil . . ."

"Right here. Where are you?"

"We've got the ship as close off planet as we can without being spot-

ted. You want the first summaries now, or shall I wait till you come up?"

"Go ahead now." Stil blanked his mind.

Jad's voice said, "The history of the place seems about as we expected. Here's a reconstruction based on the data so far."

On the globe, light lines snaked over mountains and plains, to show the boundaries of nations and racial groups. As each boundary was completed, a voice spoke briefly, saying "Greece, Cathage, Rome, India . . ." With each name Stil saw in a flash the characteristic national traits and habits, the more outstanding attitudes being symbolized by special shades of color, which gradually shifted over the globe as the armies marched and races migrated.

Brief flashes of light marked the inventions of new methods and devices, and Stil saw the effects of these in long-term processes that gradually gathered momentum.

The outward shifts of power now became more rapid, and accelerated into a series of violent upheavals that exploded and regathered till they locked into two huge power groups where the flow of colors brightened and intensified, and vast potential changes seemed to quiver on the verge of reality.

Stil held his breath, waiting. Then Jad's voice said, "At this point, Kife appeared on the scene. He found that one nation, the United States, had many immigrated minority groups still speaking the languages of their mother countries. Kife decided to carry out the initial language training in the United States, where living conditions were good, and where he'd have his men fairly well together. This worked, as far as language-teaching was concerned. Unfortunately, Kife's men also picked up the philosophy and attitudes of the place where they were living. Then Kife sent teams of them to places like the Soviet Union and China."

On the big globe, there flared into life here and there, a shade of color that contrasted glaringly with the color around it. Most of this new color was instantly snuffed out. But scattered fragments survived stubbornly. In the region called China, one began to enlarge like the vortex of a hurricane. It drew in and overpowered the color around it. It grew larger and larger. In the neighboring Soviet Union, the prevailing color wavered, then intensified. Bright lines arced out toward China. In a series of violent nuclear explosions, the transplanted color flared, broke into fragments, and finally died away. This same shade intensified sharply around the globe in the United States.

"That," said Jad, "was what they call 'the twenty-eight days' in China. The result has been to create terrific new tensions within each power bloc. At the same time both are shaken by the ferocity of what happened. This business seems to be what ruined Kife. A number of Kife's men, incidentally, were captured and brutally

tortured. In the process, their implanted tranceivers were found. The eastern bloc now thinks this means a fantastic scientific breakthrough by the western bloc. The eastern scientists are working on it day and night. At the same time, agents of the western bloc are reporting this to their superiors, who *know* the stuff wasn't theirs."

Stil drew in a deep breath. "Any reports on those sets Kife has distributed?"

"Not many. We've been concentrating on the background material I just showed you. But I think I can give you a few typical reactions."

The blue-and-green globe vanished. In quick succession, Stil saw a series of scenes:

1) A knot of wide-eyed men clutched beer cans as they huddled around a screen where a shapely woman slid a sweater over her head.

2) A group of tough but cheerful-looking men took copious notes as they watched bank officials methodically lock the vault for the day.

3) A poorly dressed man and woman shook their heads and grinned at each other as they watched an expensively dressed man and woman go through a savage quarrel on a big screen.

4) A man in a blue uniform with a microphone close by watched other men in blue fan out and approach the rear of a store adjoining a bank building.

5) A big cabinet sat with a blank screen by a bench, the works from inside the cabinet spread out on top of the bench with two men squinting at them, one of whom turned to the other and said, "Like hell we made it, Fred. And the Russkies didn't either."

The scenes faded out. Jad said, "We'll have a lot more for you later on. This seems to be typical for right now. The only other items of note are that several of these sets are on their way by fast plane to other nations, and the United States has slapped a ban on further sale of the sets in their own country. Whether the ban will last, I don't know."

Stil lay silent a moment, thinking. "How does it strike you this will develop from now on?"

"Like lightning."

"That's what I think. We may need force here, and plenty of it."

"There's a single shock group coming on the run. It's all we can expect till that business on Aret VI is stamped out."

Stil nodded. "Well, get in touch with me as soon as you have a good sampling of later reactions to the device. I'm going to stay till morning and get a first-hand impression of the atmosphere here. I'll be up shortly afterward.

Stil thought over what he'd learned, then went back to sleep. He was awakened shortly after sunrise by the tingling of his alarm watch. He washed, dressed quickly, and went out into the corridor.

He went into Kife's outer office, and found half the office staff trying to look busy, while the other half

huddled in little groups over the reports, and quarreled about how to present them to Kife. The door to Kife's office was tightly shut. Stil took a look around, then left word that he was going back to his ship.

He entered one of the booths under the building, held his tab to the scanning slot in its wall, and waited. He had time for his usual twinge of dread at the thought of his body transmuted to electromagnetic waves, bounced from transmitter to relay to relay to receiver, and reassembled again far away. Then the walls of the booth seemed to jump slightly. Stil opened the door and stepped out in the sector control ship, *Co-ordinator.*

Stil walked down the corridor, glanced briefly into busy offices, nodded to hurrying aides, and turned in at a doorway marked "Emergency Control." Several minor officials sprang to attention, and ushered him through a huge room filled with screens, big three-dimensional charts, rows of uniformed men and women at desks and files, and a long curving bank of communications booths with people entering and leaving. In the center of this maze sat a long-limbed man in a swivel chair within a wide, ring-shaped desk. He wore a light headset and a pained look as he stabbed buttons of coded shapes and colors set in sloping banks atop the desk. He glanced up as Stil crossed the floor, and waved a hand in greeting. A section of the desk slid back, and Stil stepped through.

"How is it?" said Stil.

"Terrible," said Jad. "Here, take a look." He handed Stil another headset. As Stil slid it on, he found himself looking at several men in a small room with a couple of flags standing against the wall. Two of the men were standing tensely beside chairs, one was at the edge of the desk, and the other was standing with his head tilted slightly forward, his left hand at his chin. This man looked up, and nodded.

"All right. Go ahead. There's a certain risk involved, but we'll have to take it." The room emptied in a rush.

Stil took off the headset. "What was that?"

Jad looked up. "The President of the United States deciding to lift the ban on RTV sets. Did that look like chaos or panic to you?"

Stil shook his head gloomily. "Any other developments?"

"Well, if there's a technical nation on this planet that hasn't got several of the sets apart by now, I don't know where it is."

"Any disorders?"

"A number of fist fights, so far. A few minor shooting incidents. Nothing big. The trouble is, the local police departments got the sets, too, so they're in a position to break up most of the big trouble before it has a chance to get started."

Stil nodded. "The way it's turning out, I can't see anything to do but wait and hope. We might get the kind of chaos we can use. But I don't expect it."

"Me, either. This is going to be a job for the troops."

A few moments later, Stil went to his own office, had breakfast sent in, and got started on the accumulated problems of Sector government. Shortly before lunch, he caught the faint varying inward whistle that told him someone was trying to reach him.

"Hello, Stil?"

"Right here, Dinal."

"Where are you?"

"Back on the ship."

"Anything new?"

"The situation's getting more out of hand, as we expected. But it's too soon to be sure what will happen next."

"What are you planning to do?"

"We're going to wait. It's all we can do. Kife's distribution of the sets seems to be going smoothly. There's still a remote chance things will work out as he predicts. If we were to pull him out now, there would be a lapse in authority down there that might ruin what little chance remains. If worst comes to worst . . . well, we've got troops coming."

Dinal was silent a moment. Then he said, "I hope it works out. This business, right on the heels of that mess on Aret VI, over in Noral's sector, has the Chief in quite a state."

Stil shook his head. They gloomily wished each other luck, then Stil sent out for lunch, and turned to a report from Jad: "Here's the latest, such as it is: Abortive riot in New York, First Privacy League being formed in Boston. Stupefaction in Moscow over design of the set. Peiping warns it has established a no-viewing boundary thirty miles offshore. By actual count, incidentally, there are at this moment seven hundred eighty-two sets focused on China, and several of these sets are in Moscow. This latest survey still shows no tendency that might develop into anything useful to us."

This feeling lasted from one day to the next as the situation on the planet wavered, but refused to collapse into chaos. He immersed himself in routine work punctuated by brief reports from Jad. Among the many reports, some stood out:

"So far, eighty-six murders, one hundred seventeen holdups, eight suicides, and nine hundred sixty-five arrests traceable to RTV sets."

"Uproar in the United Nations over American display of sets focused on Hungary, Tibet, a prison in Moscow, and assorted horrors inside China. Soviet Union Purchasing Commission is now shipping sets home in wholesale lots.

"American display of sets in Moscow showing typical United States workers' homes. Rival Russian display of massed sets across the street focused on assortment of United States slums, ghost towns, and economically-depressed areas—also labeled 'typical United States workers' homes.'

"Scattered acts of assault due to overexcitement on part of viewers. Various ineffectual bills in national legislatures to restrict use of sets."

Stil now received word of a new

outbreak on Aret VI The shock group racing toward Earth was turned around and sent rushing back in the opposite direction. Stil fired off angry messages to no avail, then called Jad.

"I know," said Jad. "By the time they get back to Aret, the trouble will be over. After all that time under full boost, the shock group will be right back where it started from. Next, new orders will come down for them to rush here under all possible boost. The troops will get here one hundred per cent overdue and so worn out they'll be worthless. The staff orders men around as if the central matter transform network were already stretched out over the whole universe."

"What's Kife doing now?"

"Getting ready to release a damper attachment that will cut out interference. Then people will be able to view other people even if those others have sets installed. Without the troops to back us up, it looks to me like our last chance; but I don't have any great hopes for it."

Stil nodded, then went back to work. He had the sensations of a man fighting a fire in his own back yard, and seeing the fire equipment rush directly past and vanish into the distance. As the days passed, new reports increased his uneasiness:

"Sets now widespread, sold all over the western bloc nations, and imported in huge quantities into the eastern bloc, largely to disrupt western reception."

"Kife is now marketing his interference damper in hopes people will be infuriated by sight of others invading their privacy."

"Extensive snooping has now convinced each big power bloc that the other did not originate the viewer. Both are now trying to find out who did."

"Damper is not having its expected effect. There is widespread anger over loss of privacy, but most violence is directed at sellers of dampers. As people using viewers are not generally interested in viewing other people using viewers, little trouble comes from that. Worse yet, there seems to be a considerable sprinkling of people who go their way regardless of viewers. The evident peace of mind of these people is starting to generate a certain amount of imitation, which is extremely bad from our viewpoint."

"A number of American and Russian viewers are now talking direct to each other on damper-equipped sets, using signs or interpreters to trade views, and meanwhile picking up each other's languages. Many violent disagreements; but what I don't like is, they are finding too many common interests Too much mutual admiration is going on. If the leaders of the western and eastern blocs should stop being afraid of each other and start looking around for a new enemy, then we'll have the galloping nightmare after us."

Stil wiped his brow. He went to see Jad, and found him looking exceptionally sour.

"Listen," said Stil, "where are those troops now?"

"Just starting out again from Aret VI. Naturally, they won't get here in time.

"There are so many research groups and private individuals working on sets down there that we can't monitor them all. One of them has evidently discovered a built-in block in the sets. Now the block is a block no more. It used to jam reception, to keep Kife's underground headquarters out of view. But now we discover no less than eight sets tuned in on Kife and his headquarters. Pretty soon, they'll spot his various local branches, too."

Stil took a deep breath. "That ends it. Order Kife to evacuate."

"Kife has cracked up."

"Then put someone else in charge and bundle Kife out of there."

Jad shrugged and held out a spare headset. "Here, take a look."

Stil frowned, and settled the set on his head. A scene flared up before him. He recognized Kife's outer office, the screens untended, the office staff reeling around with half-empty bottles, or huddled around blankets to rattle little cups from which small, black-dotted white cubes shot out.

Stil took off the headset and said angrily, "We've *got* to get them and their records out of there. We'll have to use the ship's crew and guards, and we'd better get together as many volunteers as we can lay hands on"

Stil watched the forced evacuation on a big screen that showed Kife's headquarters in cross-section The situation was made tense by the arrival aboveground of a monster earth auger on a huge truck trailer, followed by a motorized convoy bristling with American troops. While Stil tensely watched his men hustle Kife and his drunken crew into the matter transmitters, the gigantic auger rose up into drilling position.

Stil watched the auger eat into the ground. He stared at the discharged dirt piling up rapidly, and raised his microphone. "Never mind carrying out these files," he ordered. "Slag everything room by room and get out."

The men went from door to door, using guns on wide beam to destroy files and equipment.

The auger ate a big hole down to the top of the building with uncanny accuracy, then pulled out of the way. Two trucks trundled over carrying a metal frame between them, and stopped so the frame was right over the hole. From the frame, ropes and chain ladders with pipe crosspieces dropped into the hole, along with a cable bearing electric-light bulbs at intervals. Several long lines of troops wound over to the hole and started down, the lightly armed ones dropping fast down the ropes, the heavily-laden ones using the ladders.

Stil mopped his forehead. While his men were finishing up on the bottom floor, Earth troops were dropping in on the top floor. The end came in an exchange of ricocheting bullets and searing lines of light. An instant after Stil's men were through

the matter transmitters, explosive packets were set back the other way and blew the transmitters to pieces. But despite Stil's hardest effort, he was too late in reaching some of Kife's local branches.

When it was all over, Stil felt drugged from nervous strain and fatigue.

An aide now hurried over. "A call at Communications Booth I, sir."

Stil went to the booth, stepped in, and shut the door. The booth darkened, and a full-length screen flared to life. Directly before him stood a man in a neat dark suit, who now spoke in a low, hoarse voice.

"Every move you have made in the last hour, I have watched."

Stil forced himself to say, "Yes, sir."

"The net result of this operation is a disaster."

"Yes, sir."

"You may be interested to know what happened to the officer who sent Shock Group 68 back and forth through space to no purpose."

The screen flickered. Directly before Stil, a body hung on a rope.

The screen flickered again. Stil stiffened his knees. The low rough voice said, "Intelligent work is rewarded. Incompetence is punished."

"Yes, sir."

The screen went blank.

Stil swallowed. He mopped his brow and drew a deep breath. He stepped out of the booth, and the presence of people hustling about normally in the room surprised him. He stopped at Jad's desk. Jad had a screen set up before him, and motioned to Stil to take a look.

The screen was divided to show two scenes, each of a man in a laboratory jacket, standing before another screen with a disassembled viewer before him. Each man appeared on the other's screen. One held up a wire leading into a maze of circuits. The other nodded, drew rapidly on a pad, and held it up. The first man beamed, and pointed to part of another disassembled set.

Stil said, "What's *that?*"

"A couple of Earth's leading scientists in happy collaboration. They don't talk the same language—but nevertheless, they just got an idea to extend the range of these sets. I was hoping they wouldn't hit on that technique for a hundred years."

" 'Extend the range'?" said Stil. "Extend it *how far?*"

"They can reach from here almost to Aret VI, if they gang enough of those sets together."

Stil stood motionless as the meaning of this sank in.

Jad said, "If they set up relays at intervals, as we do, there is no theoretical limit. But even without that, they can reach a long, long distance."

"And transmission is practically instantaneous?"

"Yeah."

Stil nodded wearily, "Meanwhile, they have a heavily-populated planet geared for maximum production, already verging on space flight, requiring only a common enemy to channel their efforts, and a little more techni-

cal know-how to make them deadly. This place could make Aret VI look like a vacation. How long till those troops get here?"

"About fifteen days. They'll be in bad shape, of course, because they'll have traveled, all-told, a total of twice the distance under maximum boost, with hardly any rest at all."

"Any chance of reinforcements?"

"If Aret VI doesn't erupt again—which is problematical—we might get some from there. From anywhere else, the transportation problem is pretty tough."

"All right," said Stil. "Tell me if what I say is true. If we try to suppress this planet in its present state, using a comparative handful of worn-out troops, all we'll do is unite them permanently, and set them going on feverish preparation for interstellar war."

"Right."

"On the other hand, if we stay here and do nothing, they'll complete their long-range sets, spot us, go over our ship from one end to the other, record everything they see, and finish up with enough technical knowledge to build a fleet of their own."

"Right again. In fact, it will take so long for us to get out of range, that they'll probably do that."

"And then they'll be in a position to send shiploads of troops and viewers to Aret VI, for instance, and create a horrible situation.

"Or, if, to keep them from learning our secrets we blow this ship and everything in it, including ourselves, to little bits, that will temporarily unhinge the government of the whole sector, because all the plans, records, and strands of control are centered in this ship."

Jad nodded sourly. "Yeah. And with the unrest resulting from this Aret business, a lapse in sector government right now could be deadly. What is there left to do?"

Stil said sourly, "Practice smiling."

It was a week later that the big tender from the giant control ship landed on the planet. As the ramp slid down, and Stil stepped out, the cheering crowds waved and threw their hats in the air. A big loudspeaker boomed out a continuous commentary, of which Stil was able to make out occasional fragments:

". . . Our galactic friends . . . wise and beneficent elder race from beyond the stars . . . bearer of wonderful gifts of science . . . partners . . . despite temporary unfortunate misunderstanding . . . one-hundred year trade treaty and mutual nonaggression pact . . ."

Stil beamed with determined friendliness as the leader of United Earth pumped his hand.

It seemed to Stil that the Earth leader ought decently to have waited a little longer before thrusting out his pen for Stil to sign the trade treaty.

But Stil was careful to smile and sign with no delay.

After all, a lot of eyes were watching him.

THE END

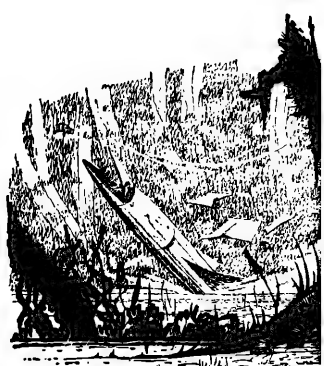
DEATHWORLD

By HARRY HARRISON

Conclusion. Is a swarm of locusts a "natural catastrophe"? What distinction—what line—can be drawn between "natural enemies," competitive species, and "natural catastrophes"...?"

Illustrated by van Dongen

SYNOPSIS



Jason dinAlt *is a professional gambler. He is understandably suspicious when a total stranger,* Kerk Pyrrus, *gives him twenty-seven million credits in cash to gamble with. Kerk is a mystery. Though middle-aged, he is the strongest man with the fastest gun Jason has ever met. His planet, Pyrrus, needs three billion credits at once. This can only be obtained by gambling. Jason is to keep all winnings above this figure for himself.*

It is impossible for Jason to say no. He wins the money by using his

psi power, the ability to control the fall of dice with his mind. Kerk helps him to fight free of the gambling casino: they escape together. Only then does Jason discover that the money is to be used to purchase war materials. His anger fades when Kerk explains that the battle is against a planet—not against sentient creatures.

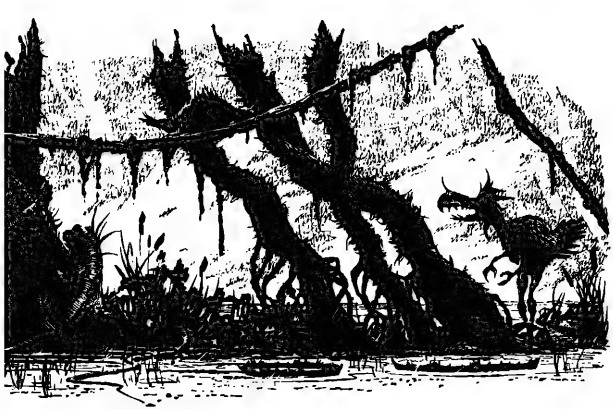
Pyrrus is a planet where mankind doesn't belong—yet it has been settled for three hundred years. The gravity is twice that of Earth. The climate varies from tropic to arctic daily, and the native beasts are fierce beyond imagining. The average life expectancy of the Pyrran settlers is sixteen years.

Instead of being frightened, Jason finds himself inversely attracted to this deadly world. He forces reluctant permission from Kerk to let him return on the Pyrran ship. They fight their way off the planet and join the cargo ship, Pyrrus bound.

The pilot of the ship is a young and lovely girl, Meta. *Jason likes her and is with her constantly during the trip. But after the ship lands he has no time for her or anything else. Staying alive is a full-time job.*

Pyrrus is far worse than he imagined. The gravity is a constant, tiring burden, and nightmares destroy his sleep. He cannot leave the sealed buildings of the survival school until he has completed weary months of training.

When he gains the proficiency in survival to leave the school, he makes some startling observations. The Pyrrans are slowly losing their battle for survival. In a few more centuries



they will all be dead at the present rate of population loss. Kerk almost kills him when he discusses this taboo topic, but is halted by astonishment when Jason tells him there is a way to end the war.

All of the Pyrran life forms have an unnatural hatred of mankind. And are constantly altering to become more deadly. The factors indicate that there is some force controlling this planet-wide attack. Jason obtains Kerk's permission to look for this hidden factor.

Jason searches for any historical records that might help him, but finds none. There are only technical works in the library, all other records and books have been destroyed by vermin. Jason kicks at the litter in anger and uncovers a metal box, made to hold a spaceship's log.

The box contains the log of the ship that brought the first settlers to Pyrrus. In the log is proof that the human population has declined. Plus the almost unbelievable fact that in the beginning all Pyrran life was friendly to humans. With renewed hope, Jason searches for the factor that caused this change.

Before he can do anything the Pyrran life forms launch a fierce attack on the human city, and Jason tries to help. He is only in the way and a Pyrran is killed saving his life. The man was Kerk's son, and in his anger Kerk orders Jason to leave on the next ship.

Jason will not admit defeat. He continues his search and discovers a well kept Pyrran secret. There are human beings living outside of the city, beyond the protective wall. The city people call them "grubbers," traitors to the human race, and shoot them on sight. They apparently have learned how to live on this deadly planet and Jason is sure they have the answers to his questions. He succeeds in escaping the city, but is attacked and captured by the grubbers.

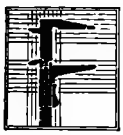
He is taken to Rhes, *one of the leaders, who is desperately ill. Jason cures him with his medikit. No longer a prisoner, he looks for the secret of Pyrrus. These jungle people are outwardly barbarians, but hold fast to a culture that is anything but barbaric. It is only by accident that he discovers that many of them are telepathic, that they control their animals in this manner.*

The parts of the puzzle are slipping into place. It is soon obvious that all Pyrran life forms are telepathic. The city is washed in waves of hatred, a psionic message of destruction that keeps the native Pyrran life in constant attack.

After promising Rhes that he will do everything he can to help the jungle dwellers, he gets back into the city. Now they have to listen to him. Jason describes the telepathic-controlled war that is being waged against them. There is some power that is beaming a message of hate against the city, keeping it under constant attack. Jason wants to find the source of this message, contact whoever or whatever is keeping the war going, and come to terms. End the battle once and for all.

PART 3

XX.



ROM the beginning now," Kerk said. "And leave out nothing."

"There is very little more that I can add to the physical facts. I saw the animals, understood the message. I even experimented with some of them and they reacted to my mental commands. What I must do now is track down the source of the orders that keep this war going.

"I'll tell you something that I have never told anyone else. I'm not only lucky at gambling. I have enough psi ability to alter probability in my favor. It's an erratic ability that I have tried to improve for obvious reasons. During the past ten years I managed to study at all of the centers that do psi research. Compared to other fields of knowledge it is amazing how little they know. Basic psi talents can be improved by practice, and some machines have been devised that act as psionic amplifiers. One of these, used correctly, is a very good directional indicator."

"You want to build this machine?" Kerk asked.

"Exactly. Build it and take it outside the city in the ship. Any signal strong enough to keep this centuries-old battle going should be strong enough to track down. I'll follow it, contact the creatures who are sending it, and try to find out why they are doing it. I assume you'll go along with any reasonable plan that will end this war?"

"Anything reasonable," Kerk said coldly. "How long will it take you to build this machine?"

"Just a few days if you have all the parts here," Jason told him.

"Then do it. I'm canceling the flight that's leaving now and I'll keep the ship here, ready to go. When the machine is built I want you to track the signal and report back to me."

"Agreed," Jason said, standing up. "As soon as I have this hole in my back looked at I'll draw up a list of things needed."

A grim, unsmiling man named Skop was assigned to Jason as a combination guide and guard. He took his job very seriously, and it didn't take Jason long to realize that he was a prisoner-at-large. Kerk had accepted his story, but that was no guarantee that he believed it. At a single word from him, the guard could turn executioner.

The chill thought hit Jason that undoubtedly this was what would happen. Whether Kerk accepted the story or not—he couldn't afford to take a chance. As long as there was the slightest possibility Jason had contacted the grubbers, he could not be allowed to leave the planet alive. The woods people were being simple if they thought a plan this obvious might succeed. Or had they just gambled on the very long chance it

might work? *They* certainly had nothing to lose by it.

Only half of Jason's mind was occupied with the work as he drew up a list of materials he would need for the psionic direction finder. His thoughts plodded in tight circles, searching for a way out that didn't exist. He was too deeply involved now to just leave. Kerk would see to that. Unless he could find a way to end the war and settle the grubber question he was marooned on Pyrrus for life. A very short life.

When the list was ready he called Supply. With a few substitutions, everything he might possibly need was in stock, and would be sent over. Skop sank into an apparent doze in his chair and Jason, his head propped against the pull of gravity by one arm, began a working sketch of his machine.

Jason looked up suddenly, aware of the silence. He could hear machinery in the building and voices in the hall outside. What kind of silence then—?

Mental silence. He had been so preoccupied since his return to the city that he hadn't noticed the complete lack of any kind of psi sensation. The constant wash of animal reactions was missing, as was the vague tactile awareness of his PK. With sudden realization he remembered that it was always this way inside the city.

He tried to listen with his mind —and stopped almost before he began. There was a constant press of thought about him that he was made aware of when he reached out. It was like being in a vessel far beneath the ocean, with your hand on the door that held back the frightening pressure. Touching the door without opening it, you could feel the stresses, the power pushing in and waiting to crush you. It was this way with the psi pressure on the city. The unvoiced hate-filled screams of Pyrrus would instantly destroy any mind that received them. Some function of his brain acted as a psi-circuit breaker, shutting off awareness before his mind could be blasted. There was just enough leak-through to keep him aware of the pressure—and supply the raw materials for his constant nightmares.

There was only one fringe benefit. The lack of thought pressure made it easier for him to concentrate. In spite of his fatigue the diagram developed swiftly.

Meta arrived late that afternoon, bringing the parts he had ordered. She slid the long box onto the workbench, started to speak, but changed her mind and said nothing. Jason looked up at her and smiled.

"Confused?" he asked.

"I don't know what you mean," she said, "I'm not confused. Just annoyed. The regular trip has been canceled and our supply schedule will be thrown off for months to come. And instead of piloting or perimeter assignment all I can do is stand around and wait for you. Then take

some silly flight following your directions. Do you wonder that I'm annoyed?"

Jason carefully set the parts out on the chasis before he spoke. "As I said, you're confused. I can point out how you're confused—which will make you even more confused. A temptation that I frankly find hard to resist."

She looked across the bench at him, frowning. One finger unconsciously curling and uncurling a short lock of hair. Jason liked her this way. As a Pyrran operating at full blast she had as much personality as a gear in a machine. Once out of that pattern she reminded him more of the girl he had known on that first flight to Pyrrus. He wondered if it was possible to really get across to her what he meant.

"I'm not being insulting when I say 'confused,' Meta. With your background you couldn't be any other way. You have an insular personality. Admittedly, Pyrrus is an unusual island with a lot of high-power problems that you are an expert at solving. That doesn't make it any less of an island. When you face a cosmopolitan problem you are confused. Or even worse, when your island problems are put into a bigger context. That's like playing your own game, only having the rules change constantly as you go along."

"You're talking nonsense," she snapped at him. "Pyrrus isn't an island and battling for survival is definitely not a game."

"I'm sorry," he smiled. "I was using a figure of speech, and a badly chosen one at that. Let's put the problem on more concrete terms. Take an example. Suppose I were to tell you that over there, hanging from the doorframe, was a stingwing—"

Meta's gun was pointing at the door before he finished the last word. There was a crash as the guard's chair went over. He had jumped from a half-doze to full alertness in an instant, his gun also searching the doorframe.

"That was just an example," Jason said. "There's really nothing there." The guard's gun vanished and he scowled a look of contempt at Jason, as he righted the chair and dropped into it.

"You both have proved yourself capable of handling a Pyrran problem," Jason continued. "But what if I said that there is a thing hanging from the doorframe that *looks* like a stingwing, but is really a kind of large insect that spins a fine silk that can be used to weave clothes?"

The guard glared from under his thick eyebrows at the empty doorframe, his gun whined part way out, then snapped back into the holster. He growled something inaudible at Jason, then stamped into the outer room, slamming the door behind him. Meta frowned in concentration and looked puzzled.

"It couldn't be anything except a stingwing," she finally said. "Nothing else could possibly look like that.

And even if it didn't spin silk, it would bite if you got near, so you would have to kill it." She smiled with satisfaction at the indestructible logic of her answer.

"Wrong again," Jason said. "I just described the mimic-spinner that lives on Stover's Planet. It imitates the most violent forms of life there, does such a good job that it has no need for other defenses. It'll sit quietly on your hand and spin for you by the yard. If I dropped a shipload of them here on Pyrrus, you never could be sure when to shoot, could you?"

"But they are not here now," Meta insisted.

"Yet they could be quite easily. And if they were, all the rules of your game would change. Getting the idea now? There are some fixed laws and rules in the galaxy—but they're not the ones you live by. Your rule is war unending with the local life. I want to step outside your rule book and end that war. Wouldn't you like that? Wouldn't you like an existence that was more than just an endless battle for survival? A life with a chance for happiness, love, music, art—all the enjoyable things you have never had the time for."

All the Pyrran sternness was gone from her face as she listened to what he said, letting herself follow these alien concepts. He had put his hand out automatically as he talked, and had taken hers. It was warm and her pulse fast to his touch.

Meta suddenly became conscious of his hand and snapped hers away, rising to her feet at the same time. As she started blindly towards the door, Jason's voice snapped after her.

"The guard, Skop, ran out because he didn't want to lose his precious two-value logic. It's all he has. But you've seen other parts of the galaxy, Meta, you know there is a lot more to life than kill-and-be-killed on Pyrrus. You feel it is true, even if you won't admit it."

She turned and ran out the door.

Jason looked after her, his hand scraping the bristle on his chin thoughtfully. "Meta, I have the faint hope that the woman is winning over the Pyrran. I think that I saw —perhaps for the first time in the history of this bloody war-torn city —a tear in one of its citizen's eyes."

XXI.

"Drop that equipment and Kerk will undoubtedly pull both your arms off," Jason said. "He's over there now, looking as sorry as possible that I ever talked him into this."

Skop cursed under the bulky mass of the psi detector, passing it up to Meta who waited in the open port of the spaceship. Jason supervised the loading, and blasted all the local life that came to investigate. Horndevils were thick this morning and he shot four of them. He was last aboard and closed the lock behind him.

"Where are you going to install it?" Meta asked.

"You tell me," Jason said. "I need a spot for the antenna where there will be no dense metal in front of the bowl to interfere with the signal. Thin plastic will do, or if worst comes to worst I can mount it outside the hull with a remote drive."

"You may have to," she said. "The hull is an unbroken unit, we do all viewing by screen and instruments. I don't think . . . wait . . . there is one place that might do."

She led the way to a bulge in the hull that marked one of the lifeboats. They went in through the always-open lock, Skop struggling after them with the apparatus.

"These lifeboats are half buried in the ship," Meta explained. "They have transparent front ports covered by friction shields that withdraw automatically when the boat is launched."

"Can we pull back the shields now?"

"I think so," she said. She traced the launching circuits to a junction box and opened the lid. When she closed the shield relay manually, the heavy plates slipped back into the hull. There was a clear view, since most of the viewport projected beyond the parent ship.

"Perfect," Jason said. "I'll set up here. Now how do I talk to you in the ship?"

"Right here," she said. "There's a pretuned setting on this communicator. Don't touch anything else—and particularly not this switch." She pointed to a large pull-handle set square into the center of the control board. "Emergency launching. Two seconds after that is pulled the lifeboat is shot free. And it so happens this boat has no fuel."

"Hands off for sure," Jason said. "Now have Husky there run me in a line with ship's power and I'll get this stuff set up."

The detector was simple, though the tuning had to be precise. A dish-shaped antenna pulled in the signal for the delicately balanced detector. There was a sharp fall-off on both sides of the input so direction could be precisely determined. The resulting signal was fed to an amplifier stage. Unlike the electronic components of the first stage, this one was drawn in symbols on white paper. Carefully glued-on input and output leads ran to it.

When everything was ready and clamped into place, Jason nodded to Meta's image on the screen. "Take her up—and easy please. None of your nine-G specials. Go into a slow circle around the perimeter, until I tell you differently."

Under steady power the ship lifted and grabbed for altitude, then eased into its circular course. They made five circuits of the city before Jason shook his head.

"The thing seems to be working fine, but we're getting too much noise from all the local life. Get

thirty kilometers out from the city and start a new circuit."

The results were better this time. A powerful signal came from the direction of the city, confined to less than a degree of arc. With the antenna fixed at a right angle to the direction of the ship's flight, the signal was fairly constant. Meta rotated the ship on its main axis, until Jason's lifeboat was directly below.

"Going fine now," he said. "Just hold your controls as they are and keep the nose from drifting."

After making a careful mark on the setting circle, Jason turned the receiving antenna through one hundred eighty degrees of arc. As the ship kept to its circle, he made a slow collecting sweep of any signals beamed at the city. They were halfway around before he got a new signal.

It was there all right, narrow but strong. Just to be sure he let the ship complete two more sweeps, and he noted the direction on the gyrocompass each time. They coincided. The third time around he called to Meta.

"Get ready for a full right turn, or whatever you call it. I think I have our bearing. Get ready—*now*."

It was a slow turn and Jason never lost the signal. A few times it wavered, but he brought it back on. When the compass settled down Meta pushed on more power.

They set their course towards the native Pyrrans.

An hour's flight at close to top atmospheric speed brought no change. Meta complained, but Jason kept her on course. The signal never varied and was slowly picking up strength. They crossed the chain of

volcanoes that marked the continental limits, the ship bucking in the fierce thermals. Once the shore was behind and they were over water, Skop joined Meta in grumbling. He kept his turret spinning, but there was very little to shoot at this far from land.

When the islands came over the horizon the signal began to dip.

"Slow now," Jason called. "Those islands ahead look like our source!"

A continent had been here once, floating on Pyrrus' liquid core. Pressures changed, land masses shifted, and the continent had sunk beneath the ocean. All that was left now of the teeming life of that land mass was confined to a chain of islands, once the mountain peaks of the highest range of mountains. These islands, whose sheer sides rose straight from the water, held the last inhabitants of the lost continent. The weeded out descendants, of the victors of uncountable violent contests. Here lived the oldest native Pyrrans.

"Come in lower," Jason signaled. "Towards that large peak. The signals seem to originate there."

They swooped low over the mountain, but nothing was visible other than the trees and sun-blasted rock.

The pain almost took Jason's head off. A blast of hatred that drove through the amplifier and into his skull. He tore off the phones, and clutched his skull between his hands. Through watering eyes he saw the black cloud of flying beasts hurtle up from the trees below. He had a single glimpse of the hillside beyond before Meta blasted power to the engines and the ship leaped away.

"We've found them!" Her fierce exhultation faded as she saw Jason through the communicator. "Are you all right? What happened?"

"Feel . . . burned out . . . I've felt a psi blast before, but nothing like that! I had a glimpse of an opening, looked like a cave mouth, just before the blast hit. Seemed to come from there."

"Lie down," Meta said. "I'll get you back as fast as I can. I'm calling ahead to Kerk, he has to know what happened."

A group of men were waiting in the landing station when they came down. They stormed out as soon as the ship touched, shielding their faces from the still-hot tubes. Kerk burst in as soon as the port was cracked, peering around until he spotted Jason stretched out on an acceleration couch.

"Is it true?" he barked. "You've traced the alien criminals who started this war?"

"Slow, man, slow," Jason said. "I've traced the source of the psi message that keeps your war going. I've found no evidence as to who started this war, and certainly wouldn't go so far as to call them criminals—"

"I'm tired of your word-play," Kerk broke in. "You've found these creatures and their location has been marked."

"On the chart," Meta said, "I could fly there blindfolded."

"Fine, fine," Kerk said, rubbing his hands together so hard they could hear the harsh rasp of the callouses. "It takes a real effort to grasp the idea that, after all these centuries, the war might be coming to an end. But it's possible now. Instead of simply killing off these self-renewing legions of the damned that attack us, we can get to the leaders. Search them out, carry the war to them for a change—and blast their stain from the face of this planet!"

"Nothing of the sort!" Jason said, sitting up with an effort. "Nothing doing! Since I came to this planet I have been knocked around, and risked my life ten times over. Do you think I have done this just to satisfy your blood-thirsty ambitions? It's peace I'm after—not destruction. You promised to contact these creatures, attempt to negotiate with them. Aren't you a man of honor who keeps his word?"

"I'll ignore the insult—though I'd have killed you for it at any other time," Kerk said. "You've been of great service to our people, we are not ashamed to acknowledge an honest debt. At the same time—do not accuse me of breaking promises that I never made. I recall my exact words. I promised to go along with any reasonable plan that would end this war. That is just what I intend to do. Your plan to negotiate a peace is not reasonable. Therefore we are going to destroy the enemy."

"Think first," Jason called after Kerk, who had turned to leave. "What is wrong with trying negotiation or an armistice? Then, if that fails, you can try your way."

The compartment was getting crowded as other Pyrrans pushed in. Kerk, almost to the door, turned back to face Jason.

"I'll tell you what's wrong with armistice," he said. "It's a coward's way out, that's what it is. It's all right for you to suggest it, you're from off-world and don't know any better. But do you honestly think I could entertain such a defeatist notion for one instant? When I speak, I speak not only for myself, but for all of us here. We don't mind fighting, and we know how to do it. We know that if this war was over we could build a better world here. At the same time, if we have the choice of continued war or a cowardly peace—*we vote for war.* This war will only be over when the enemy is utterly destroyed!"

The listening Pyrrans shouted in agreement, and when Kerk pushed out through the crowd some of them patted his shoulder as he went by. Jason slumped back on the couch, worn out by his exertions and exhausted by the attempt to win the violent Pyrrans over to a peaceful point of view.

When he looked up they were gone—all except Meta. She had the same look of blood-thirsty elation as the others, but it drained away when she glanced at him.

"What about it, Meta," he asked bitterly. "No doubts? Do you think that destruction is the only way to end this war?"

"I don't know," she said. "I can't be sure. For the first time in my life I find myself with more than one answer to the same question."

"Congratulations," he said. "It's a sign of growing up."

XXII.

Jason stood to one side and watched the deadly cargo being loaded into the hold of the ship. The Pyrrans were in good humor as they stowed away riot guns, grenades and gas bombs. When the back-pack atom bomb was put aboard one of them broke into a marching song, and the others picked it up. Maybe they were happy, but the approaching carnage only filled Jason with an intense gloom. He felt that somehow he was a traitor to life. Perhaps the life form he had found needed destroying—and perhaps it didn't. Without making the slightest attempt at conciliation, destruction would be plain murder.

Kerk came out of the operations building and the starter pumps could be heard whining inside the ship. They would leave within minutes. Jason forced himself into a foot-dragging rush and met Kerk halfway to the ship.

"I'm coming with you, Kerk. You owe me at least that much for finding them."

Kerk hesitated, not liking the idea. "This is an operational mission," he said. "No room for observers, and the extra weight— And it's too late to stop us Jason, you know that."

"You Pyrrans are the worst liars in the universe," Jason said. "We both know that ship can lift ten times the amount it's carrying today. Now . . . do you let me come, or forbid me without reason at all?"

"Get aboard," Kerk said. "But keep out of the way or you'll get trampled."

This time, with a definite destination ahead, the flight was much faster. Meta took the ship into the stratosphere, in a high ballistic arc that ended at the islands. Kerk was in the co-pilot's seat, Jason sat behind them where he could watch the screens. The landing party, twenty-five volunteers, were in the hold below with the weapons. All the screens in the ship were switched to the forward viewer. They watched the green island appear and swell, then vanish behind the flames of the braking rockets. Jockeying the ship carefully, Meta brought it down on a flat shelf near the cave mouth.

Jason was ready this time for the blast of mental hatred—but it still hurt. The gunners laughed and killed gleefully as every animal on the island closed in on the ship. They were slaughtered by the thousands, and still more came.

"Do you have to do this," Jason asked. "It's murder—carnage, just butchering those beasts like that."

"Self-defense," Kerk said. "They attack us and they get killed. What could be simpler. Now shut up, or I'll throw you out there with them."

It was a half an hour before the gunfire slackened. Animals still attacked them, but the mass assaults seemed to be over. Kerk spoke into the intercom.

"Landing party away—and watch your step. They know we're here and will make it as hot as they can. Take the bomb into that cave and see how far back it runs. We can always blast them from the air, but it'll do no good if they're dug into solid rock. Keep your screen open, leave the bomb and pull back at once if I tell you to. Now move."

The men swarmed down the ladders and formed into open battle formation. They were soon under attack, but the beasts were picked off before they could get close. It didn't take long for the man at point to reach the cave. He had his pickup trained in front of him, and the watchers in the ship followed the advance.

"Big cave," Kerk grunted. "Slants back and down. What I was afraid of. Bomb dropped on that would just close it up. With no guarantee that anything sealed in it, couldn't eventually get out. We'll have to see how far down it goes."

There was enough heat in the cave now to use the infra-red filters. The rock walls stood out harshly black and white as the advance continued.

"No signs of life since entering the cave," the officer reported. "Gnawed bones at the entrance and some bat droppings. It looks like a natural cave—so far."

Step by step the advance continued, slowing as it went. Insensitive as the Pyrrans were to psi pressure, even they were aware of the blast of hatred being continuously leveled at them. Jason, back in the ship, had a headache that slowly grew worse instead of better.

"Watch out!" Kerk shouted, staring at the screen with horror.

The cave was filled from wall to wall with pallid, eyeless animals. They poured from tiny side passages and seemed to literally emerge from the ground. Their front ranks dissolved in flame, but more kept pressing in. On the screen the watchers in the ship saw the cave spin dizzily as the operator fell. Pale bodies washed up and concealed the lens.

"Close ranks—flame throwers and gas!" Kerk bellowed into the mike.

Less than half of the men were alive after that first attack. The survivors, protected by the flame throwers, set off the gas grenades. Their sealed battle armor protected them while the section of cave filled with gas. Someone dug through the bodies of their attackers and found the pickup.

"Leave the bomb there and withdraw," Kerk ordered. "We've had enough losses already."

A different man stared out of the screen. The officer was dead. "Sorry, sir," he said, "but it will be just as easy to push ahead as back as long as the gas grenades hold out. We're too close now to pull back."

"That's an order," Kerk shouted, but the man was gone from the screen and the advance continued.

Jason's fingers hurt where he had them clamped to the chair arm. He pulled them loose and massaged them. On the screen the black and white cave flowed steadily towards them. Minute after minute went by this way. Each time the animals attacked again, a few more gas grenades were used up.

"Something ahead—looks different," the panting voice cracked from the speaker. The narrow cave slowly opened out into a gigantic chamber, so large the roof and far walls were lost in the distance.

"What are those?" Kerk asked. "Get a searchlight over to the right there."

The picture on the screen was fuzzy and hard to see now, dimmed by the layers of rock in-between. Details couldn't be made out clearly, but it was obvious this was something unusual.

"Never saw . . . anything quite like them before," the speaker said. "Look like big plants of some kind, ten meters tall at least—yet they're moving. Those branches, tentacles or whatever they are, keep pointing towards us and I get the darkest feeling in my head . . ."

"Blast one, see what happens," Kerk said.

The gun fired and at the same instant an intensified wave of mental hatred rolled over the men, dropping them to the ground. They rolled in pain, blacked out and unable to think or fight the underground beasts that poured over them in renewed attack.

In the ship, far above, Jason felt the shock to his mind and wondered how the men below could have lived through it. The others in the control room had been hit by it as well. Kerk pounded on the frame of the screen and shouted to the unhearing men below.

"Pull back, come back . . ."

It was too late. The men only stirred slightly as the victorious Pyrran animals washed over them, clawing for the joints in their armor. Only one man moved, standing up and beating the creatures away with his bare hands. He stumbled a few feet and bent over the writhing mass below him. With a heave of his shoulders he pulled another man up. The man was dead but his shoulder pack was still strapped to his back. Bloody fingers fumbled at the pack, then both men were washed back under the wave of death.

"That was the bomb!" Kerk shouted to Meta. "If he didn't change the setting, it's still on ten second minimum. Get out of here!"

Jason had just time to fall back on the acceleration couch before the

rockets blasted. The pressure leaned on him and kept mounting. Vision blacked out but he didn't lose consciousness. Air screamed across the hull, then the sound stopped as they left the atmosphere behind.

Just as Meta cut the power a glare of white light burst from the screens. They turned black instantly as the hull pickups burned out. She switched filters into place, then pressed the button that rotated new pickups into position.

Far below, in the boiling sea, a climbing cloud of mushroom shaped flame filled the spot where the island had been seconds before. The three of them looked at it, silently and unmoving. Kerk recovered first.

"Head for home Meta, and get operations on the screen. Twenty-five men dead, but they did their job. They knocked out those beasts—whatever they were—and ended the war. I can't think of a better way for a man to die."

Meta set the orbit, then called operations.

"Trouble getting through," she said. "I have a robot landing beam response, but no one is answering the call."

A man appeared on the empty screen. He was beaded with sweat and had a harried look in his eyes. "Kerk," he said, "is that you? Get the ship back here at once. We need her firepower at the perimeter. All blazes broke loose a minute ago, a general attack from every side, worse than I've ever seen."

"What do you mean?" Kerk stammered in unbelief. "The war is over—we blasted them, destroyed their headquarters completely."

"The war is going like it never has gone before," the other snapped back. "I don't know what you did, but it stirred up the stewpot of hell here. Now stop talking and get the ship back!"

Kerk turned slowly to face Jason, his face pulled back in a look of raw animal savagery.

"You—! You did it! I should have killed you the first time I saw you. I wanted to, now I know I was right. You've been like a plague since you came here, sowing death in every direction. I knew you were wrong, yet I let your twisted words convince me. And look what has happened. First you killed Welf. Then you murdered those men in the cave. Now this attack on the perimeter—all who die there, you will have killed!"

Kerk advanced on Jason, step by slow step, hatred twisting his features. Jason backed away until he could retreat no further, his shoulders against the chart case. Kerk's hand lashed out, not a fighting blow, but an open slap. Though Jason rolled with it, it still battered him and stretched him full length on the floor. His arm was against the chart case, his fingers near the sealed tubes that held the jump matrices.

Jason seized one of the heavy tubes with both hands and pulled it out. He swung it with all his strength into Kerk's face. It broke

the skin on his cheekbone and forehead and blood ran from the cuts. But it didn't slow or stop the big man in the slightest. His smile held no mercy as he reached down and dragged Jason to his feet.

"Fight back," he said, "I will have that much more pleasure as I kill you." He drew back the granite fist that would tear Jason's head from his shoulders.

"Go ahead," Jason said, and stopped struggling. "Kill me. You can do it easily. Only don't call it justice. Welf died to save me. But the men on the island died because of your stupidity. I wanted peace and you wanted war. Now you have it. Kill me to soothe your conscience, because the truth is something you can't face up to.

With a bellow of rage Kerk drove the pile driver fist down.

Meta grabbed the arm in both her hands and hung on, pulling it aside before the blow could land. The three of them fell together, half crushing Jason.

"Don't do it," she screamed. "Jason didn't want those men to go down there. That was your idea. You can't kill him for that!"

Kerk, exploding with rage, was past hearing. He turned his attention to Meta, tearing her from him. She was a woman and her supple strength was meager compared to his great muscles. But she was a Pyrran woman and she did what no offworlder could. She slowed him for a moment, stopped the fury of his attack until he could rip her hands loose and throw her aside. It didn't take him long to do this, but it was just time enough for Jason to get to the door.

Jason stumbled through, and jammed shut the lock behind him. A split second after he had driven the bolt home Kerk's weight plunged into the door. The metal screamed and bent, giving way. One hinge was torn loose and the other held only by a shred of metal. It would go down on the next blow.

Jason wasn't waiting for that. He hadn't stayed to see if the door would stop the raging Pyrran. No door on the ship could stop him. Fast as possible, Jason went down the gangway. There was no safety on the ship, which meant he had to get off it. The lifeboat deck was just ahead.

Ever since first seeing them, he had given a lot of thought to the lifeboats. Though he hadn't looked ahead to this situation, he knew a time might come when he would need transportation of his own. The lifeboats had seemed to be the best bet, except that Meta had told him they had no fuel. She had been right in one thing—the boat he had been in had empty tanks, he had checked. There were five other boats, though, that he hadn't examined. He had wondered about the idea of useless lifeboats and come to what he hoped was a correct conclusion.

This spaceship was the only one the Pyrrans had. Meta had told him once that they always had planned to buy another ship, but never did.

Some other necessary war expense managed to come up first. One ship was really enough for their uses. The only difficulty lay in the fact they had to keep that ship in operation or the Pyrran city was dead. Without supplies they would be wiped out in a few months. Therefore the ship's crew couldn't conceive of abandoning their ship. No matter what kind of trouble she got into, they couldn't leave her. When the ship died, so did their world.

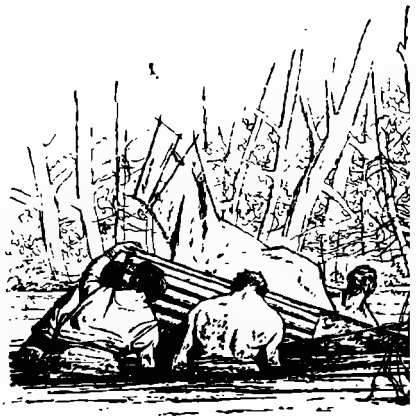
With this kind of thinking, there was no need to keep the lifeboats fueled. Not all of them, at least. Though it stood to reason at least one of them held fuel for short flights that would have been wasteful for the parent ship. At this point Jason's chain of logic grew weak. Too many "ifs". *If* they used the lifeboats at all, one of them should be fueled. *If* they did, it would be fueled now. And *if* it were fueled—which one of the six would it be? Jason had no time to go looking. He had to be rght the first time.

His reasoning had supplied him with an answer, the last of a long line of suppositions. If a boat were fueled, it should be the one nearest to the control cabin. The one he was diving towards now. His life depended on this string of guesses.

Behind him the door went down with a crash. Kerk bellowed and leaped. Jason hurled himself through the lifeboat port with the nearest thing to a run he could manage under the doubled gravity. With both hands he grabbed the emergency launching handle and pulled down.

An alarm bell rang and the port slammed shut, literally in Kerk's face. Only his Pyrran reflexes saved him from being smashed by it.

Solid-fuel launchers exploded and blasted the lifeboat clear of the parent ship. Their brief acceleration slammed Jason to the deck, then he



floated as the boat went into free fall. The main drive rockets didn't fire.

In that moment Jason learned what it was like to know he was dead. Without fuel the boat would drop into the jungle below, falling like a rock and blasting apart when it hit. There was no way out.

Then the rockets caught, roared, and he dropped to the deck, bruising his nose. He sat up, rubbing it and grinning. There was fuel in the tanks—the delay in starting had only been part of the launching cycle, giving the lifeboat time to fall clear of the ship. Now to get it under

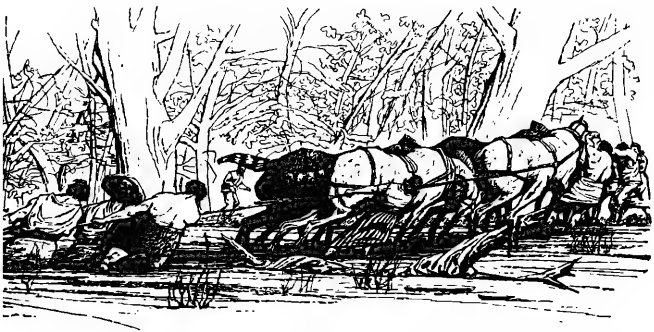
control. He pulled himself into the pilot's seat.

The altimeter had fed information to the autopilot, leveling the boat off parallel to the ground. Like all lifeboat controls these were childishly simple, designed to be used by novices in an emergency. The autopilot could not be shut off, it rode along with the manual controls, tempering foolish piloting. Jason hauled the control wheel into a tight turn and the autopilot gentled it to a soft curve.

Through the port he could see the big ship blaring fire in a much tighter turn. Jason didn't know who was flying it or what they had in mind—he took no chances. Jamming the wheel forward into a dive he cursed as they eased into a gentle drop. The larger ship had no such restrictions. It changed course with a violent maneuver and dived on him. The forward turret fired and an explosion at the stern rocked the little boat. This either knocked out the autopilot or shocked it into submission. The slow drop turned into a power dive and the jungle billowed up.

Jason pulled the wheel back and there was just time to get his arms in front of his face before they hit.

Thundering rockets and cracking trees ended in a great splash. Silence followed and the smoke drifted away. High above, the spaceship circled hesitantly. Dropping a bit as if wanting to go down and investigate. Then rising again as the urgent message for aid came from the city. Loyalty won and she turned and spewed fire towards home.



XXIII.

Tree branches had broken the lifeboat's fall, the bow rockets had burned out in emergency blast, and the swamp had cushioned the landing a bit. It was still a crash. The battered cylinder sank slowly into the

stagnant water and thin mud of the swamp. The bow was well under before Jason managed to kick open the emergency hatch in the waist.

There was no way of knowing how long it would take for the boat to go under, and Jason was in no condition to ponder the situation. Concussed and bloody, he had just enough drive left to get himself out. Wading and falling he made his way to firmer land, sitting down heavily as soon as he found something that would support him.

Behind him the lifeboat burbled and sank under the water. Bubbles of trapped air kept rising for a while, then stopped. The water stilled and, except for the broken branches and trees, there was no sign that a ship had ever come this way.

Insects whined across the swamp, and the only sound that broke the quiet of the woods beyond was the cruel scream of an animal pulling down its dinner. When that had echoed away in tiny waves of sound everything was silent.

Jason pulled himself out of the half trance with an effort. His body felt like it had been through a meat grinder, and it was almost impossible to think with the fog in his head. After minutes of deliberation he figured out that the medikit was what he needed. The easy-off snap was very difficult and the button release didn't work. He finally twisted his arm around until it was under the orifice and pressed the entire unit down. It buzzed industriously, though he couldn't feel the needles, he guessed it had worked. His sight spun dizzily for a while then cleared. Pain-killers went to work and he slowly came out of the dark cloud that had enveloped his brain since the crash.

Reason returned and loneliness rode along with it. He was without food, friendless, surrounded by the hostile forces of an alien planet. There was a rising panic that started deep inside of him, that took concentrated effort to hold down.

"Think Jason, don't emote," he said it aloud to reassure himself, but was instantly sorry, because his voice sounded weak in the emptiness, with a ragged edge of hysteria to it. Something caught in his throat and he coughed to clear it, spitting out blood. Looking at the red stain he was suddenly angry. Hating this deadly planet and the incredible stupidity of the people who lived on it. Cursing out loud was better and his voice didn't sound as weak now. He ended up shouting and shaking his fist at nothing in particular, but it helped. The anger washed away the fear and brought him back to reality.

Sitting on the ground felt good now. The sun was warm and when he leaned back he could almost forget the unending burden of doubled gravity. Anger had carried away fear, rest erased fatigue. From somewhere in the back of his mind there popped up the old platitude. *Where there's life, there's hope.* He grimaced at the triteness of the words, at

the same time realizing that a basic truth lurked there.

Count his assets. Well battered, but still alive. None of the bruises seemed very important, and no bones were broken. His gun was still working, it dipped in and out of the power holster as he thought about it. Pyrrans made rugged equipment. The medikit was operating as well. If he kept his senses, managed to walk in a fairly straight line and could live off the land, there was a fair chance he might make it back to the city. What kind of a reception would be waiting for him there was a different matter altogether. He would find that out after he arrived. Getting there had first priority.

On the debit side there stood the planet Pyrrus. Strength-sapping gravity, murderous weather, and violent animals. Could he survive? As if to add emphasis to his thoughts, the sky darkened over and rain hissed into the forest, marching towards him. Jason scrambled to his feet and took a bearing before the rain closed down visibility. A jagged chain of mountains stood dimly on the horizon, he remembered crossing them on the flight out. They would do as a first goal. After he had reached them, he would worry about the next leg of the journey.

Leaves and dirt flew before the wind in quick gusts, then the rain washed over him. Soaked, chilled, already bone tired, he pitted the tottering strength of his legs against the planet of death.

When nightfall came it was still raining. There was no way of being sure of the direction, and no point in going on. If that wasn't enough, Jason was on the ragged edge of exhaustion. It was going to be a wet night. All the trees were thick-boled and slippery, he couldn't have climbed them on a one-G world. The sheltered spots that he investigated, under fallen trees and beneath thick bushes, were just as wet as the rest of the forest. In the end he curled up on the leeward side of a tree, and fell asleep, shivering, with the water dripping off him.

The rain stopped around midnight and the temperature fell sharply. Jason woke sluggishly from a dream in which he was being frozen to death, to find it was almost true. Fine snow was sifting through the trees, powdering the ground and drifting against him. The cold bit into his flesh, and when he sneezed it hurt his chest. His aching and numb body only wanted rest, but the spark of reason that remained in him, forced him to his feet. If he lay down now, he would die. Holding one hand against the tree so he wouldn't fall, he began to trudge around it. Step after shuffling step, around and around, until the terrible cold eased a bit and he could stop shivering. Fatigue crawled up him like a muffling, gray blanket. He kept on walking, half the time with his eyes closed. Opening them only when he fell and had to climb painfully to his feet again.

The sun burned away the snow

clouds at dawn. Jason leaned against his tree and blinked up at the sky with sore eyes. The ground was white in all directions, except around the tree where his stumbling feet had churned a circle of black mud. His back against the smooth trunk, Jason sank slowly down to the ground, letting the sun soak into him.

Exhaustion had him light-headed, and his lips were cracked from thirst. Almost continuous coughing tore at his chest with fingers of fire. Though the sun was still low it was hot already, burning his skin dry. Dry and hot.

It wasn't right. This thought kept nagging at his brain until he admitted it. Turned it over and over and looked at it from all sides. What wasn't right? The way he felt.

Pneumonia. He had all the symptoms.

His dry lips cracked and blood moistened them when he smiled. He had avoided all the animal perils of Pyrrus, all the big carnivores and poisonous reptiles, only to be laid low by the smallest beast of them all. Well, he had the remedy for this one, too. Rolling up his sleeve with shaking fingers, he pressed the mouth of the medikit to his bare arm. It clicked and began to drone an angry whine. That meant something, he knew, but he just couldn't remember what. Holding it up he saw that one of the hypodermics was projecting halfway from its socket. Of course. It was empty of whatever antibiotic the analyzer had called for. It needed refilling.

Jason hurled the thing away with a curse, and it splashed into a pool and was gone. End of medicine, end of medikit, end of Jason dinAlt. Single-handed battler against the perils of deathworld. Strong-hearted stranger who could do as well as the natives. It had taken him all of one day on his own to get his death warrant signed.

A choking growl echoed behind him. He turned, dropped and fired in the same motion. It was all over before his conscious mind was aware it had happened. Pyrran training had conditioned his reflexes on the precortical level. Jason gaped at the ugly beast dying not a meter from him and realized he had been trained well.

His first reaction was unhappiness that he had killed one of the grubber dogs. When he looked closer he realized this animal was slightly different in markings, size and temper. Though most of its forequarters were blown away, blood pumping out in dying spurts, it kept trying to reach Jason. Before the eyes glazed with death it had struggled its way almost to his feet.

It wasn't quite a grubber dog, though chances were it was a wild relative. Bearing the same relation as dog to wolf. He wondered if there were any other resemblances between wolves and this dead beast. Did they hunt in packs, too?

As soon as the thought hit him he looked up—not a moment too soon. The great forms were drifting

(*Continued on page* 129)

MARS:

A SUMMING UP

By R. S. Richardson

We've all thought about the frightful climate anything trying to live on Mars would have to endure. Yes . . . but did you know Earth has at least one considerable area that has a climate just as extreme?

ITH all the developments in space travel that are going on it might seem that we should be hearing a good deal about Mars, the planet on which there is the best chance of finding life. On the contrary, it is my prediction that you will hear very little about Mars in the next few years. The reason is that Mars is going to be too far away to attract the attention of even the relatively few astronomers who make planetary work their specialty.

About every two years Earth passes Mars in its orbit when the planet is fairly close. At such a time Mars appears opposite the Sun in the sky and is said to be in opposition. But owing to the eccentric shape of the planet's orbit some oppositions are much better than others. At a close opposition Mars is distant about thirty-five million miles. At an unfavorable opposition Mars may be distant as much as sixty-three million miles. In the last six years we have had three favorable oppositions. Now we are entering upon a series of unfavorable oppositions when the planet is going to be too far away to show interesting detail. Not until 1971 will Mars swing

within thirty-five million miles again.

Judging from some conversations I have had with space technologists they are in the peculiar position of having to justify their projects before they can get any money for them. That is, you can't get money for a rocket probe simply because you want to learn more about Mars. You have to advance specific reasons *why* you want to send a rocket probe to Mars. The answer would seem to be that for the next ten years Mars is going to be so far away that even if observations could be carried out from a space satellite they would be on such a small scale as to tell us very little. If we wish to learn more about Mars in the coming years, it looks as if we will have to reverse the usual procedure, and, instead of waiting patiently for the planet to come to us, we will have to go to the planet. Those who wish to send a rocket probe to Mars are anxious for all the information they can get to strengthen their position. Now that Mars is receding from Earth, perhaps we should take stock of the recent knowledge gained about it, and see where we stand on the foremost problems regarding the Red Planet.

I should say that our principal efforts have gone into exploring the Martian atmosphere and in trying to determine the nature of the dark areas that girdle the planet in the southern hemisphere. Curiously enough scarcely anything new has emerged about the canals, the objects of most interest to the general public. This is probably because the canals can still only be observed visually, and recent observations have mostly been made either photographically or with some electronic device. In other words, astronomers have been so busy trying to *measure* something on Mars they have not had time just to *look* at it. In 1954 a television-like instrument called the image intensifier gave hope of detecting the canal system, but apparently it was not used with success at the oppositions of 1956 and 1958. We will have more to say about the canals later.

First let us discuss the dark regions of Mars which are of intense interest since they may be the site of life. If so, they are the only indications of life we have in the whole universe outside Earth. Our ideas regarding the dark regions have undergone radical changes in the last hundred years and there is much about them that still remains a mystery.

Previous to 1877 there was no mystery about the dark regions whatever. They were supposed to be seas and were called *maria,* like the seas on the Moon. Back in those days Mars was confidently believed to be a world very similar to Earth, with plenty of water on its surface and an ample supply of oxygen in its atmosphere.

The first intimation that all might not be quite as it seemed was raised by two South American astronomers, Liais and Cruls of Rio de Janeiro in 1878, who suggested that the maria might be vegetation instead of seas. At times so much detail was glimpsed

Longitude de l'équinoxe de printemps boréal	=	84°.0	- Beginning of northern spring.
Longitude du solstice d'été boréal	=	174°.0	Beginning of northern summer.
Longitude de l'équinoxe d'automne boréal	=	264°.0	Beginning of northern autumn.
Longitude du solstice d'hiver boréal	=	354°.0	Beginning of northern winter.
Distance moyenne au Soleil	=	227,7.10⁶ km = 1,5237 U.A.	Mean distance from the Sun.
Excentricité de l'orbite	=	0,0933	Excentricity of the orbit.
Longitude du périhélie	=	334°35'	Longitude of perihelion.
Inclinaison du plan de l'orbite	=	1°51'	Inclination of the orbit.
Longitude du nœud ascendant	=	48°56'.5	Longitude of ascending node.
Durée de révolution	=	686 j 23 h 30 m 41 s	Martian year.
Coordonnées célestes de l'axe de rotation	α	316°.8 δ + 53°.0	Celestial coordinates of the axis of rotation
Inclinaison de l'axe sur la normale à l'orbite	=	24°.8	Inclination of the axis of rotation.
Durée de rotation du globe	=	24 h 37 m 22 s .6	Martian day.
Diamètre équatorial du globe	=	0,530 6760 km	Equatorial diameter.
Valeur de 1" planétocentrique sur le disque	=	60 km	1" Planetocentric at the surface.

This map of Mars and the accompanying tables give the latest official list of names of the Martian features as designated by the International Astronomical Union. Also important data pertaining to the orbit and orientation of the planet.

in the maria that it was hard to believe they were seas and oceans unless the water was very shallow. Then some bright person pointed out that, if the maria actually were sheets of water, we should be able to see the reflected image of the sun in them, and nothing of the sort had ever been sighted. Gradually as more and better observations became available the vegetation hypothesis was strengthened, until by 1900 it was generally agreed that the maria consisted of some low form of plant life, although astronomers were a bit vague about the "low" part.

The chief argument in favor of the vegetation hypothesis has been the way the maria change with the seasons. The maria change color with the seasons, but the changes are not marked and rather hard to specify. The principal change that occurs is one of *tone* rather than *tint*. In the fall and winter the maria are dim and their outline poorly defined. With the coming of spring the maria around the polar cap begin to darken, and this darkening gradually spreads toward the equator like a wave, traveling at the rate of about thirty miles per day.

The inference is that moisture emanating from the polar cap in the spring is spreading over the surface causing the dormant vegetation to spring to life. The difficulty comes in trying to figure out how the moisture makes contact with the vegetation. The polar cap covers a wide area, but all the evidence indicates it is very thin, possibly only a couple of inches in depth. In the cold rarified atmosphere of Mars it is doubtful if much melting occurs. It is more likely that the polar snows disappear by sublimation—by evaporation—rather than melting. In any case, there is no such thing as a polar sea as was once supposed.

In the spring a dark band is visible around the polar cap that seems to be real and not merely an effect of contrast, but its nature is unknown. It was formerly explained as a ring of marshy ground surrounding the polar cap, but now it seems doubtful if there is even this much water available. Apparently the only way water can be carried over the surface is by atmospheric circulation in the form of a dry gas. The amount of moisture must be exceedingly slight judged by terrestrial standards. How this little bit of moisture can cause such a marked development in plant life is hard to understand.

The maria are variously described in textbooks as being green or gray-green, but in 1956 and 1958 they were distinctly bluish gray. In fact, early in the Martian spring of 1956 they appeared to me as light blue. Color estimates are notoriously liable to error, especially in the case of the maria surrounded by the bright tawny colored deserts. The most careful estimates of the color of the maria were made in 1956 by G. P. Kuiper using the eighty-two-inch reflector of the McDonald Observatory in Texas. He did this at the telescope with a color chart illuminated by artificial light of

sunlight quality. He described the colors of the maria as neutral gray, with a mere touch of moss-green in some of the equatorial regions and a touch of brown around the south polar cap.

From the lack of vivid colors in the maria at the 1954 and 1956 oppositions, when it was spring in the southern hemisphere, Kuiper believes that an inorganic explanation of the maria be considered along with the vegetative hypothesis. The most probable inorganic hypothesis is that the maria are lava fields similar to those on the Moon and Mercury, which have a partial covering of some very hardy vegetation. The maria may also change appearance as they are periodically covered with dust. Of course this is straddling the issue. It is somehow more satisfactory to have the maria all one thing or the other.

It is possible to make an elementary test that will at least tell us whether the maria are covered by chlorophyll-bearing vegetation or not. Suppose you take a photograph of grass and trees with a plate and filter combination that gives deep red light only. On such a photograph green vegetation will come out dark as shown in Figure 1. This is because chlorophyll reflects red light very poorly; in fact, chlorophyll has an absorption band in the deep red so that, if you look at a landscape through a deep-red filter, the trees and grass will look black to you. Chlorophyll also reflects blue and violet light poorly. It does reflect yellow-green light fairly well, and since our eyes are most sensitive to this color, most vegetation looks green to us.

Now, if our eyes were sensitive just a little farther into the infrared, the landscape would probably look quite different to us, for chlorophyll begins to reflect powerfully in the infrared just beyond the range of sensitivity of our eye. Thus, if you take a photograph of grass and trees in infrared light, you get the most surprising result. All the green vegetation looks as if it were covered with snow as shown in Figure 2. For if you adjust the exposure time to make the sky come out about right the green vegetation comes out way overexposed. It looks white—the familiar "snow fall" effect.

The application to Mars is obvious. Suppose the maria are covered by green chlorophyll-bearing plants. Let us take a photograph of the planet in deep-red light. On such a photograph the maria should come out dark. Then let us photograph the planet in infrared light. On these photographs the maria should come out *bright*—possibly as bright as the deserts around them.

The dismal results of this experiment are shown in Figures 3 and 4 taken in red and infrared light in August, 1956. The maria look the same in both exposures. Evidently they cannot consist of chlorophyll-bearing plants like the green vegetation of Earth.

But other plants are known on Earth which have a different reflectivity from green vegetation. These

Fig. 1

are the lichens which reflect light about the same all through the spectrum. Also, because lichens are the hardiest plants known on Earth, it would seem that they might have a chance of surviving even under the rigorous conditions prevailing on Mars. These conditions consist of a thin atmosphere which at the surface has a pressure about the same as our atmosphere at an altitude of sixty thousand feet.

The latest tests reported in 1957 fail to show a trace of oxygen in the Martian atmosphere. It probably consists of nitrogen with a little carbon dioxide and perhaps some argon. Temperatures range from slightly above freezing at noon on the equator to around -100° F during the night. The crustose lichens found as a gray scale growing on rocks and old monuments would seem to be the plants most likely to withstand such conditions.

In the last ten years the idea of "lichen-like" plants on Mars took such a firm hold upon astronomers that they began referring to "the lichens" on Mars as if they were actually there. Of course they knew nothing of the sort. This was pointed out very forcibly at the meeting of the Mars committee in 1957 by Dr. Frank

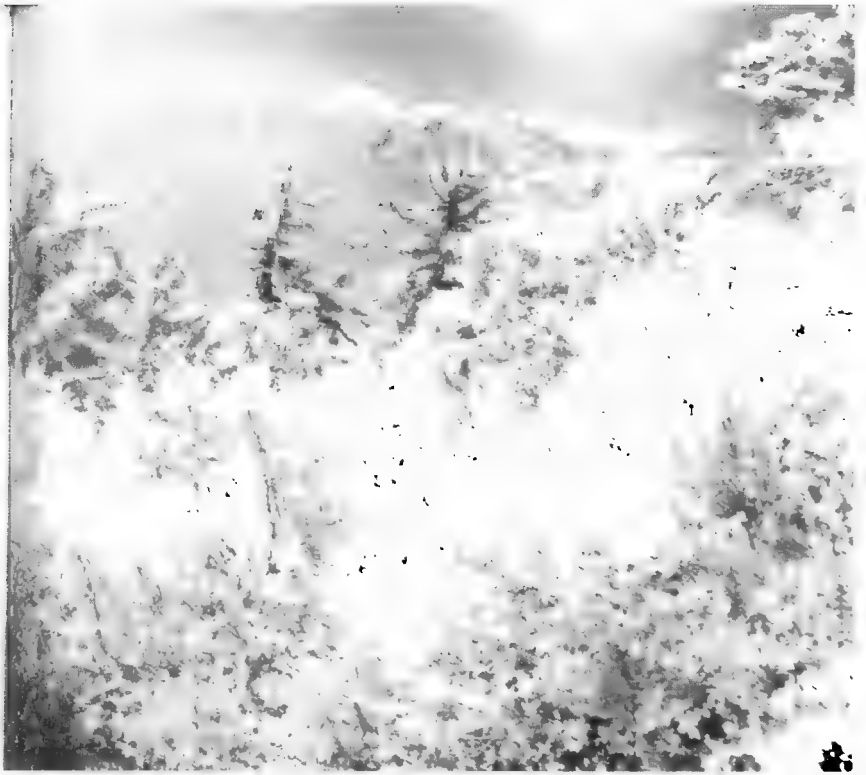


Fig. 2

Fig. 1. Mount San Antonio twenty-two miles from Mount Wilson photographed in deep red light. Notice how dark the green foliage of the trees appears in the foreground. This is because the green foliage reflects deep red light very poorly.

Fig. 2. Mount San Antonio photographed in infrared light. In this photograph the green foliage appears bright since it reflects infrared light strongly. The slopes of the mountains which are nearly barren look about the same in both photographs. Their surface may be roughly similar to the desert surface of Mars.

Salisbury, a plant ecologist. In the first place, he observed that lichens do not exhibit the color changes with the seasons that we observe on Mars. Crustose lichens are very slow growing, their rate of growth being measured in fractions of an inch per decade. Yet new dark areas have developed on Mars the size of Texas in about a year. Also, the maria have a fairly solid well-covered look, as if the vegetation covered the surface almost completely. Whereas lichens growing under desert conditions never make up a conspicuous part of the landscape. (Under very good seeing conditions during the 1958 opposition photographs were obtained of the maria quite different from usual. Instead of appearing as solid areas they were broken up into forms resembling twisted ribbons as nearly as I can describe them. If the maria could be viewed under perfect seeing conditions, they would probably show much more detail than we suspect at present.) Furthermore, although lichens are exceedingly hardy organism they are peculiarly sensitive to contamination of the air, so that they cannot tolerate city atmospheres. (Los Angeles with its smog should be a lichen desert!) For this reason lichens are seldom found growing in caves near the sea where they are partially deprived of oxygen by submergence in the water.

Salisbury concluded that life as we know it on Earth could not survive the rigors of the Martian climate and still show the effects observed in the dark areas. He believes that two biological possibilities remain: (1) that life, basically as we know it has become adapted to meet the rigors of the Martian climate. But it should be remembered that there are regions on Earth where the climate is not nearly as severe as that on Mars, which nevertheless are essentially barren. And (2), that some other form of life wholly unknown to us—a parabiology—accounts for the markings on Mars. Although discussions of this kind must remain essentially in the realm of science fiction, they may yet turn out to be the most likely possibility.

II.

In connection with the possibility of plant life becoming adapted to Martian conditions, the Russians have made some interesting experiments in the Arctic on the Pamir plateau, where the climate is almost as cold and dry as it is on Mars. They found that the reflection spectrum of plants growing under extreme cold differs from that of plants in temperate climates. The investigation proceeded under the following basic principles:

1. The laws of life in the universe are identical in essence but differ in their manifestations.

2. The ability of the living to adapt itself to external conditions is very great.

3. Plants possess optical adaptations to external conditions.

We have seen that the maria are bluish in color and do not reflect infrared light strongly like green

plants on Earth. From this we have concluded that the maria cannot consist of chlorophyll-bearing vegetation. But perhaps we have been over hasty and let a tacit assumption creep into our reasoning. We have assumed that green plants *always* reflect the same regardless of conditions. But can we be sure of this? This is the question that the astrobotanists have set themselves to answer.

The Russians found that as a general rule plants growing under extreme cold do not reflect as much light as those growing in milder climates. For example, the polar Juniper was found to reflect infrared rays by only a third the amount of green plants growing in latitude 50° N. They found also that the Tien-Shen fir tree reflects less infrared light the farther north it grows. The Tien-Shen fir shows another interesting effect with regard to the absorption band of chlorophyll in the deep red. When the temperature of the air drops below freezing the band disappears. The same effect was noted in other plants growing in high mountains near the Arctic circle. In general, evergreens were found to reflect about half as much of the red rays in winter as in summer.

Why should plants growing in extremely cold regions differ in the way they reflect light from plants growing in warmer climates? To put it crudely, for somewhat the same reason we wear heavy dark clothing in winter and thin white fabrics in summer. About half the radiant energy from the sun is contained in the invisible infrared rays. As we have seen, ordinarily plants reflect these rays strongly. But in an extremely cold climate a plant to protect itself will absorb as much radiation from the sun as possible. Therefore, it not only absorbs the infrared radiation but goes right on absorbing through the red and orange and yellow, as well. As a result, these plants do not show the characteristic absorption band of chlorophyll in the deep red. The reason is that there is no band left to show because *all* the light is absorbed. The situation might be compared to a man who has lost one of his front teeth. The missing tooth leaves a conspicuous gap in his mouth. But the gap would not be noticed if all his teeth were out.

Thus the only rays left for the Arctic plants to reflect are those in the green, blue, and violet. Hence they appear generally darker than plants growing in warm climates that reflect yellow and orange light. Dark colors are especially prominent among plants growing at an altitude of twelve thousand feet on the Pamir plateau, such as blue wormwood, blue oxytrope, and certain violets.

As for the low temperature on Mars being fatal to plant life the climate on the Pamir plateau is hardly less severe. During the year the average range in temperature of the surface soil—not the air—is 184° F, while the daily fluctuation on the surface of the soil amounts to 108° F. It is the daily range in temperature that appears to influence plants most

Fig. 3

Fig. 4

strongly. The low temperatures experienced at night only seem to harden a plant to make it more cold resistant. Thus about two hundred different plant species were found growing in the vicinity of Verkhoyansk. (The town of Verkhoyansk has the dubious honor of holding the record for the coldest spot on Earth of -96° F. The lowest temperature ever recorded in the United States seems to be a reading of -67° F in Montana.) The ability of plants to withstand low temperatures is remarkable. For example, the flower buds of the scurvy grass that grows on the Siberian shores of the Arctic Ocean can stand frosts of -50° F, sometimes without even a covering of snow, and still open and blossom in the summer.

Furthermore, the atmosphere on Mars can hardly be drier than that of the Pamir. To reach this region air currents have to cross the mountain ranges that surround it on all sides. While crossing the mountains the air currents lose their moisture which is transformed into some of the greatest glaciers and snowcaps in the world. When the air finally passes into the valleys of the Pamir it contains only an insignificant amount of moisture. At noon the relative humidity is practically zero.

There is still the difficulty about oxygen. Although this work on astrobotany was done at a great altitude where the air was exceedingly thin, still there was an abundance of oxygen present compared with the

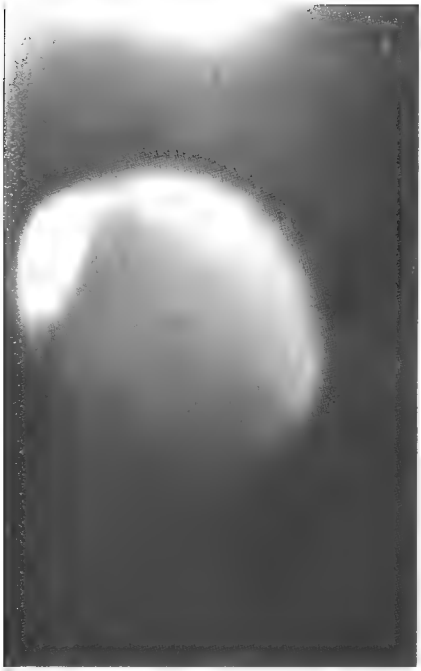


Fig. 5

Fig. 3. Mars photographed in red light on August 10, 1956 with the 60-inch telescope on Mount Wilson.
$10^h\ 19^m$ UT. Longitude of central meridian is 13.

Fig. 4. Mars photographed in infrared light on August 11, 1956 with the 60-inch telescope on Mount Wilson.
$11^h\ 49^m$ UT. Longitude of the central meridian is 26.
In this infrared photograph which shows the same markings as in Fig. 3 there is no increase in brightness as we would expect if the dark markings are covered with green chlorophyll containing vegetation.

Fig. 5. Mars photographed in blue light with the 60-inch telescope on Mount Wilson, on June 3, 1956. White area is the south polar cap. The planet shows no markings in blue light. This image which always reminded me of a stuffed olive shows the difficulty of trying to measure the shape of the disk from a photograph. The difference in contrast together with the phase which is always present to some extent make such measures very liable to error.

most we can allow on Mars. In photosynthesis plants take in carbon dioxide and give off oxygen, which they obtain from the decomposition of water. Now oxygen liberated by vegetation is believed to be one of the chief sources of this gas in our atmosphere. If so, then why cannot we detect oxygen over the extensive dark regions of Mars? Also, in respiration plants take in oxygen from the air and give off carbon dioxide, a process that goes on continuously day and night.

The astrobotanists do not attempt to give a definite answer to these questions. They merely point out that plants besides releasing oxygen to the air may also preserve it, both in their above-ground parts and in their roots.

Plants growing in boggy soils may suffer from lack of oxygen, but most bog and aquatic plants have become adapted to such conditions by acquiring considerable stocks of oxygen in their bodies by means of wide intercellular spaces and respiratory root systems. Of course, these are only a few ways that plants are known to adapt themselves to small quantities of oxygen. Martian plants doubtless have quite different methods.

We cannot but admire the fortitude of the Russian scientists in making this bleak investigation. Imagine starting out on some subzero morning with a dog team to measure the reflection spectrum of a Christmas tree!

III.

Because of the difficulties encountered by the vegetative hypothesis some have contended that the maria do not consist of plant life at all but instead are mineral deposits. This idea seems to have originated with the noted Swedish chemist, Arrhenius, about fifty years ago, but was never taken very seriously. Recently it has been revived by Dean B. McLaughlin of the University of Michigan, who has elaborated upon it and worked it out in great detail. The argument upon which it is based proceeds somewhat as follows:

Anyone who inspects a map of Mars can hardly fail to be struck by the peculiar form and orientation of the dark markings bordering the equator. Particularly noteworthy are the funnel-shaped "bays" ending in sharp points such as the Syrtis Major, the Forks of Aryn, the Margaritifer Sinus, and the Mare Cimmerium. These features have a uniformly twisted appearance. First they curve toward the southwest. Then as they cross the equator into the northern hemisphere they curve back in the opposite direction toward the east. This curvature is so definite it seems incredible that it can be the result of chance. Some common agency must have been operating to produce the effect.

McLaughlin believes this agency is the Martian winds. The wavy pattern of the dark bands represents deposits of material drifted by these winds. The pattern is so well-marked and permanent owing to the fact that the flow of winds on Mars is not disturbed by oceans and mountains, as on Earth.

To account for the form of the markings we have to consider a significant difference between seasons on Earth and those on Mars. On Earth the seasons are caused almost entirely by the tilt of the Earth's axis relative to the sun. The distance of the Earth from the sun changes so little during the year that its effect upon the seasons is negligible.

Not so on Mars. The distance of Mars from the sun ranges over twenty-six million miles during the course of a revolution, or by twenty per cent on either side of the average. The tilt of the Martian axis and the changing distance of the planet from the sun combine to make the southern summers shorter and warmer

than those in the northern hemisphere. Conversely, the winters in the northern hemisphere are longer and colder than those in the south.

Since the southern summer is considerably the hotter the Martian winds will presumably be the strongest at this time. Hence the main pattern of drifted material will be established in the southern hemisphere. Also, during the southern summer the so-called "heat" equator will be shifted considerably south of the geographic equator. (To be strictly accurate I suppose we should say the *areographic* equator.) Accordingly, the northeast trade winds will flow across the equator, but soon afterward the rotation of the planet will deflect them to the left so that they become northwest anti-trade winds. Thus McLaughlin believes he has an explanation for the curious twisted appearance of the markings that border the equator on the south. They extend across the equator slanting slightly toward the west, then hook backward toward the southwest.

Now the question arises: What would cause the peculiar funnel shaped dark bays ending in a point?

McLaughlin is convinced there can be but one answer—volcanoes. The tips of the bays mark the positions of volcanoes whose ash is carried by the winds and deposited in the peculiar pattern we see. There would appear to be more than a score of great volcanoes lying along a belt encircling the planet at an angle of roughly 25°. Canals extending from the pointed bays toward the north are interpreted as drifts of ash from the volcanoes during the period of weaker reversed wind flow in the northern summer.

Thus on this hypothesis the dark regions instead of representing vegetation are nothing more exciting than lifeless deposits of volcanic ash. Evidence is presented to show that common types of volcanic ash exposed to the carbon dioxide of the Martian atmosphere would result in minerals of a greenish color, such as chlorite, epidote, and serpentine. The seasonal changes are ascribed to the arrival of moisture from the polar cap, together with new falls of ash due to changes in wind flow.

Judging from remarks that I have heard and some published comments, the volcanic-aeolian hypothesis of the Martian features has failed to win many adherents. It must be admitted, however, that it is hard to put your finger on any one point that is fatally wrong with it. The objection has been raised that if there were widespread volcanic action on Mars we should be able to detect water vapor in the planet's atmosphere, since water is by far the most abundant volcanic gas. So far all attempts to detect lines of water vapor in the spectrum of Mars have failed, although the test is difficult owing to the obscuring effect of water vapor lines in our own atmosphere.

I have photographed the spectrum of Mars with the 100-inch telescope letting the slit of the spectrograph fall across the maria and the adjacent desert. I thought in this way one

might be able to detect the presence of water vapor by the *difference* in the intensity of the spectrum lines, which should be stronger over the maria than the desert. No significant difference in intensity could be discerned. Of course, as McLaughlin remarks, the volcanic-aeolian hypothesis and the vegetative hypothesis are not mutually exclusive. There is no reason why you can't have *both* volcanoes and vegetation. In any case, McLaughlin would seem to have done science-fiction writers a distinct favor by introducing the idea of extensive volcanic action on Mars. It is one more thing that can happen on that inert world.

IV.

To tell anything about a body that never comes closer than thirty-five million miles taxes your ingenuity to the utmost. This is shown in the results of two recent investigations made along quite different lines which have yielded most important information on the nature of the Martian surface markings.

One of these is the polarization measures made on Mars by A. Dollfus of the Pic du Midi Observatory in the Pyrenees. Light reflected from a surface is usually partially polarized; that is, as a result of reflection some of the light waves will vibrate in a particular direction instead of at random. Polarized light is indistinguishable from ordinary light by the eye, but can readily be detected by observing it through certain crystals or polaroid. Now it happens that different substances polarize light in different ways. Thus by studying the polarization of light reflected from Mars we can learn something about the nature of the surface.

Dollfus found that the deserts of Mars produce a type of polarization given by very few substances. They indicate that the surface must be powdery, consisting of very finely separated grains, which are completely opaque despite their small size. From tests in the laboratory he found that the substance that most nearly imitates the results for Mars is pulverized limonite, an iron ore varying in color from yellow to dark brown.

Surprisingly enough he found also that the light from the dark maria is not essentially different from that of the deserts. In fact, he was able to obtain the same results for the maria by sprinkling pulverized limonite with a powder of very absorbing grains. The maria, however, did show one significant new effect. Their polarization changes with the seasons. The change was of a kind that could only be explained by variation in the nature of the surface on a microscopic scale. Physical or chemical processes in minerals were not adequate. The most reasonable supposition was that it was due to microscopic organism that covered most of the surface in certain areas. The observations indicate that the organisms must be very minute, very dark, and very absorbent.

After trying different substances, Dollfus found that certain algae,

Fig. 6. Photographs of Mars in blue light taken in 1952 with the 200-inch telescope. These images show streaks across the disk in an east-west direction reminding us of weather bands. We would expect to find weather bands on a rotating planet with a convective atmosphere. The markings shown here are not usually found on Mars.

lichens, or minute mushrooms when sprinkled on pulverized limonite, gave a polarization curve like that observed for Mars. On Earth such microscopic organisms are mostly creatures with a very great power of adaptation. Their highly absorbent character suggests a superficial colored pigment that offers protection against cold or excessive radiation, by proper selective absorption of light. Of course, these results do not *prove* the presence of such microorganisms on Mars. They merely show that the character of light reflected from the planet's surface can be closely reproduced by a suitable

combination of substances known on Earth.

Observations of quite a different kind that have yielded important information on the maria have been made by William M. Sinton. These observations depend upon the fact that the C-H molecule produces an absorption band in the infrared at 3.46 microns in all organic substances. If I understand it correctly, light reflected from any organic substance—green leaves, lichen, meat—show an absorption marking at this wave length. Therefore, if such an absorption band can be found in the spectrum of Mars, it would be proof of the presence of organic matter on the planet's surface.

The first observations were made when Mars came near in 1956 using the 61-inch reflecting telescope of the Harvard College Observatory. It was hoped that individual spots could be measured on Mars, so that the light from a dark region could be compared with that from the deserts. Since Mars radiates very feebly in the far infrared it was necessary to use an extremely sensitive detecting and amplifying system. But even with the best instrumentation obtainable it was found impossible to restrict the measures to particular parts of the disk.

To get a response out of the instrument it was necessary to use light from the whole disk, which meant that the light from the maria and deserts was all mixed together. Nevertheless, after a suitable reduction of the data a curve was obtained which showed evidence of absorption near 3.46 microns. Sinton did not trust a mere visual inspection of the curve but applied a statistical analysis to determine its significance. This analysis showed that there was less than one chance in a hundred that accidental errors were responsible for the dip in the curve.

Much better results were obtained when Mars came close in the fall of 1958, by taking observations at the 200-inch telescope which gave an image of the planet half an inch in diameter, and by using equipment ten times more sensitive than before. With this instrumentation Sinton was able to establish that absorption markings occurred in dark regions like the Syrtis Major, but were absent or very weak over the deserts. An unexpected result was that the Martian observations showed three absorption markings at 3.43, 3.56, and 3.67 microns, whereas terrestrial vegetation shows only two at 3.41 and 3.51 microns. The presence of three bands in the spectrum of Mars may indicate some significant difference in the type of molecules present on the two planets.

Thus as the result of the work of Dollfus and Sinton we have good observational evidence for the presence of some kind of "living substance" in the dark areas of Mars. The evidence is particularly strong when taken in conjunction with the seasonal changes in the dark areas. Whether we can properly call this living substance vegetation or not is

a question. With each advance it becomes increasingly evident that the biologist has the biggest stake in a trip to Mars.

V.

The question of the canals which used to agitate astronomers so much has been shoved into the background by another phenomenon which first came into prominence at the opposition of 1937. The atmosphere of Mars is quite transparent in red, orange, and yellow light, but becomes suddenly opaque in the blue about wave-length 4500A. For this reason photographs of Mars taken in blue light show only a featureless disk except for the polar cap and possibly a high cloud. No trace of surface markings is evident. But occasionally "something" happens in the Martian atmosphere. The surface features can be seen almost as clearly on blue photographs as in yellow. This "blue clearing" may last only a few days. Then the atmosphere hazes over again and the disk resumes its usual blank appearance. In 1952 I wrote an article for Astounding entitled "The Blue Mist of Mars." Since then we have learned a good deal more about how the blue mist behaves. Unfortunately this new knowledge has mystified rather than enlightened us as to the nature of the blue mist itself.

The most notable instances of blue clearing have occurred near opposition when the Sun, Earth, and Mars are approximately in a straight line. This has given rise to the idea that the blue clearing occurs *only* at opposition. The striking nature of the effect helps promote this idea. You take one blue plate of Mars after another. They show nothing but the polar cap. Then around opposition you take a blue plate and—lo and behold!—it shows the surface markings. Not as clearly as they stand out in yellow light but still strong enough so that they are easily visible. You immediately start casting around trying to connect it with something. Mars is at opposition. Opposition only happens every two years. The coincidence seems too remarkable to be the result of chance.

Yet blue clearing does not occur at every opposition. There is some evidence that when Mars is very far above or below the line joining Earth and Sun the clearing does not occur. This would indicate that Earth is critically concerned in the production of the effect. Now how can Earth have anything to do with what happens on Mars? It has been suggested that Earth's magnetic field affects charged-particle radiation from the sun, deflecting the particles from their paths, so that they fail to reach Mars in the usual amounts. Thus there are fewer charged condensation nuclei in the Martian atmosphere and as a result the atmosphere clears up for a while. Then Mars moves away from opposition, the planets are no longer in line, the charged-particle radiation from the sun reaches Mars again, and the atmosphere resumes its usual opacity in the blue.

The idea sounds plausible until you start to pry into it more critically. First of all it must be remembered that Mars is observed much more intensively around opposition than at other times. In fact, practically all observations of Mars you read about are taken within a few weeks before and after opposition. We look at Mars more at opposition. Therefore, we see more. Also, we pay more attention to Mars at close oppositions when the planet is within less than fifty million miles of us than at the more distant ones when it is sixty-three million miles away. Most of the notable instances of blue clearing have occurred at close oppositions.

G. de Vaucouleurs has just finished the first systematic study of the blue clearing made from six hundred pair of blue and yellow photographs taken at the Lowell Observatory between 1926 and 1956, and also the Lamont-Hussey Observatory in South Africa. He found there is real evidence that the atmosphere does become more transparent in the blue near opposition. There are, however, marked exceptions to the rule. De Vaucouleurs emphasizes that the amount of material on which the study was based is still small, especially for oppositions when Mars is far from Earth.

If we give up the idea that particle radiation from the sun causes the blue clearing, we immediately encounter severe difficulties. This is a wide-open field for speculation and readers' ideas on the subject may be as good as the expert's. What can happen in the Martian atmosphere to make it suddenly clear up in the blue? It seems almost certain that the bulk of the Martian atmosphere consists of nitrogen gas, with a little carbon dioxide, and possibly argon. Water vapor must be present but is extremely scarce. If we are going to conjure up a blue mist for Mars, it looks as if we will have to do it out of these substances.

This might not seem so difficult yet none of the attemps so far have been very successful. The most work on this subject has been done by Seymour Hess, a meteorologist. In 1950 he proposed a haze layer of dry ice but later withdrew it, as it appeared impossible to make it fit conditions on Mars. Quite recently he postulated a haze layer consisting of very small ice particles which scatter blue light strongly. This haze layer has an altitude of nineteen miles at the equator and is about two miles thick. His theory demands a surface frost point of -90°C, which seems abnormally low.

Harold C. Urey has criticized Hess' theory on several grounds. He points out that the blue haze has been known to clear up simultaneously over practically the entire planet. But to do so the temperature of the haze layer would have to rise uniformly over the whole planet by 10°C, and fall again by the same amount when the haze reforms. Such a planet-wide rise and fall in temperature seems very unlikely. The theory also requires that the haze layer descend to

the surface at the poles whenever surface frost exists, and in general must be lower in the colder latitudes toward the poles. If this is the case, then the images of Mars in blue light should appear noticeably oblate, being flattened at the poles and extended at the equator. No such polar flattening has ever been observed. (But trying to determine the shape of Mars photographically—Figure 5—is a terrible problem!)

Normally the blue haze covers the planet uniformly. But to do so conditions must vary over the surface in a very special way. We would expect a rotating planet with a convective atmosphere to show weather bands, due to varying degrees of condensation in different latitudes. Although some such bands were observed in 1952 and 1954, they certainly are not typical of the usual appearance of the planet. On the whole. Urey considers it very doubtful if the blue haze can be explained by any sort of condensation product in the Martian atmosphere.

An astronomer considers himself lucky if he happens to be photographing Mars during a period of blue clearing. He cannot get the use of the telescope every night so that it is often a matter of chance if he catches the planet when something interesting is going on. At the opposition of 1954 the Martian atmosphere was abnormally clear in blue light for a couple of months before opposition and cleared up in a spectacular way right at the critical date. Interesting clouds of different types were frequent on the disk at this opposition.

In 1956 Mars seemed determined not to show us anything in blue light. The disk was a featureless blank except for the brilliant south polar cap, which stood out prominently, giving the images a remarkable resemblance to a stuffed olive. It remained a blank until near opposition when blue clearing occurred on the side turned toward observers in Australia. Shortly afterward a dust storm (?) occurred which blotted out many of the markings even in red light.

As Mars approached opposition in 1958 it almost always showed some kind of markings in blue light. These markings often looked like partially transparent spots in the planet's atmosphere except that the markings in yellow light could not be seen in them. But undoubted instances of blue clearing did occur. One clear-cut example was caught seventy-four days before opposition. Also, the clearing was not planet wide or even continent wide. And the haziness can occur with remarkable speed. For example, on November 22, 1958, the disk varied from a high degree of transparency in blue light to complete opacity in only four hours.

The most incredible thing I have ever observed on Mars, which I would not believe unless I had photographic proof of its presence, was the marking first observed on my blue images taken at the 100-inch telescope on June 2nd and 3rd in 1954.

When the blue images were viewed with the south pole uppermost there was a marking near the equator which resembled the letter "W." The marking was presumably a cloud formation in the upper atmosphere. The linelike character of the marking gave it a most unusual appearance. There were knobs at the points of intersection of the strokes of the W. The width of the knobs was about two hundred eighty miles and the length of the strokes of the W about one thousand miles. The W was also photographed by E. C. Slipher in 1954 at his station in South Africa. He found that the marking had an intermittent existence, visible only on the afternoon side of the planet.

In 1958 the W marking was back again.* The knobs were not so conspicuous as before and the lines appeared finer. In 1954 we found within the errors of measurement that some of the knobs coincided with oases and a couple of the lines with well-known canals. Whether there is any real connection between the surface markings and the cloud is impossible to say. In 1958 the W marking had the most artificial look to it —almost like sky writing. We can dream up some sort of explanation for the blue clearing. But the W marking is hopeless.

VI.

So far as I am aware nothing really new has been done on the canals during the last six years. At scientific meetings they are scarcely mentioned. As Mars recedes there is less and less likelihood that anything will be done about them. Here are a few of my own ideas on the subject, since no one else's are available.

In my opinion, there has been altogether too much mystery and hocus pocus made over the canals. I think anyone with normal vision can see them provided certain conditions are satisfied. The planet should be within less than fifty million miles of Earth. The seeing conditions should be exceptionally good. It must be the right season on Mars. The canals first appear about Martian April 1st corresponding to our northern style season, and by the middle of Martian June little is left of them. Very few canals are visible during the Martian late summer, autumn, and winter. Doubtless the reason many observers have failed to see canals is simply because they looked for them at the wrong season. It is too bad that the idea of the canals as waterways ever got into the literature, for it has dominated thought on the subject until we are positively chained to it.

From what I have seen of the canals they appear to be nothing more than narrow extensions of the maria into the deserts. This is the way many experienced observers such as Schiaparelli have drawn them and in my own mind I am convinced this is what they are. This raises the question of why there should be such narrow extensions of the maria into the deserts. Now as we have seen

*I understand that E. C. Slipher also observed the W marking at the opposition of 1956.

there is good observational evidence that the maria consist of vegetation or some form of living substance. The canals appear to be made of the same stuff as the maria. I once suggested to a group of biologists at Cal-Tech that the maria send out slender creepers into the deserts. The oases or round spots found at the junction of the canals may be places where the creepers have taken root and sent out new shoots in different directions. We see such "canals" in our gardens on a small scale in the creepers from strawberry and ivy plants.

I half expected the biologists to rise as one man and throw me out of the room but instead they took it quite calmly. One even commented that since the rate of growth of such creepers is known it might be possible to check the idea from observations of the development of the canals. From my limited contact with them, I should say that the biologists who should know something about the possibilities of life on Mars are much less conservative on the subject than the astronomers, who don't know anything about it.

VII.

Summing up, our present evidence for life on Mars looks rather good. If it is vegetation, it must be of quite a different kind from that known on Earth. As Salisbury remarks, we may be dealing with a form of parabiology rather than some terrestrial life form that has adapted itself to Martian conditions.

The nature of the blue mist remains unknown. It serves Mars as a protection against ultraviolet light somewhat as our ozone layer serves us, with the difference that our ozone layer is always on the job, whereas the blue mist clears away for brief periods, usually near opposition.

The "W" marking which was such a conspicuous feature on the blue images in 1954 was back again in 1958. It is a direct refutation of the statement that there is "nothing line-like on Mars."

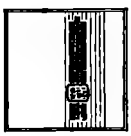
Nothing essentially new has been reported on the canals. An entirely new observing technique will evidently have to be developed before the reality of these markings can be established to everybody's satisfaction. Mars is going to be so far away for the next nine years it seems doubtful if photographs of the planet taken from an artificial satellite would be on a sufficient scale to reveal the canals. A rocket probe sent near Mars that would scan the surface and televise back information about it might be the answer. The question is could we evaluate such a picture if we had it? During instants of fine seeing while working at the telescope one catches glimpses of such a bewildering mass of detail on Mars that it leaves you gasping. Often photographs of the terrestrial landscape from a high altitude are hard to interpret. Who knows how it might be with Mars?

THE END

MICRODESIGN FOR LIVING

By ISAAC ASIMOV

It's obvious that a living animal has to have organs such as stomach, breathing mechanism, et cetera. But a living cell...? What are the necessary design units of the unit of living tissues?



N AN article I wrote a few years ago*, I described the sheer impossibility of determining the structure of an average-sized protein molecule by trial and error. In a succeeding article†, however, I described how the problem was solved, after all, by using means other than trial and error.

As usual in science, however, victories are only an excuse for setting up newer and harder problems.

It's as though we were considering a man who has tackled a house with bare hands. By pulling it slowly and painfully to pieces, he has finally managed to make note of the exact position of every beam and plank, together with the precise routes followed by the wiring and plumbing. Then as he stands there, breathlessly triumphant amid the ruins, imagine that the only reward he gets is to have someone say to him, "Good! Now put it together again."

To see the application of this little allegory, consider the protein molecule. (If you happen to be one of those who has considered it before with me, consider it again, anyway.) It is made up of some nineteen building blocks called "amino acids." An average-sized protein molecule will have five or six hundred of these amino acids strung together in some

*"HEMOGLOBIN AND THE UNIVERSE," Astounding S. F., February 1955.

†"VICTORY ON PAPER," Astounding S. F., September 1955

definite order. A large protein molecule may have hundreds of thousands. Each different molecule has its own particular order of amino acids, its own microdesign, and even minor changes in that order are important.

For instance, the normal hemoglobin molecule, usually called "Hemoglobin A" consists of two identical halves, each containing a string of almost three hundred amino acids. One nine-amino-acid section of that string has been found to have the following arrangement: A-B-C-C-D-E-F-F-G. (The different letters stand for different amino acids; the exact ones not mattering for purposes of this article.)

There is also an abnormal hemoglobin molecule which occurs in the red blood cells of people suffering from a hereditary disease called "sickle-cell anemia." This abnormal hemoglobin molecule is called "Hemoglobin S". ("S" for "sickle-cell" of course.) The Hemoglobin S molecule is also composed of two identical halves, each also containing a string of almost three hundred amino acids. Careful analysis by methods I described in "Victory On Paper" showed that the arrangement of amino acids in Hemoglobin S is almost identical with that of Hemoglobin A.

Almost, but not quite.

In the section of the string for which I gave the letter arrangement in Hemoglobin A, the corresponding arrangement in Hemoglobin S is A-B-C-C-D-E-B-F-G.

Compare the letter arrangements and you'll find that amino acid F in Hemoglobin A has been replaced by amino acid B in Hemoglobin S.

And that is all that is needed. One amino acid and only one is altered out of the three hundred in each half of the hemoglobin molecule, yet this is enough to change the molecule from a normal, adjusted and well-behaved one, to another variety which is much less soluble, which precipitates out in the red cell under certain conditions, which distorts the red cell shape and makes the cell more fragile and which, finally, can result in a serious and even fatal anemia.

Now then, to return to our earlier analogy, the biochemist has achieved the victory of having torn down the house; that is, he has ripped the insuline molecule apart and determined its structure. (And for the feat, Dr. Sanger has just been awarded a Nobel Prize.) Using the same methods, the biochemist can determine the structure of hemoglobin—and he is well on the road in that direction—or any other protein.

But one result, in the long run, will be that the pressure of scientific curiosity and the needs of society will force him then to try to put the house back together again; that is, to synthesize the protein.

"And mind you," these forces will say, "no sloppy jobs; no slipshod work. We want Hemoglobin A and not Hemoglobin S, so don't go misplacing any of the amino acids."

Now the individual amino acids are all easily available and there are well-known and not very difficult methods for getting amino acids to

combine in just the manner of combination that occurs naturally in proteins. The only difficulty comes in getting them to combine in the right order.

Chemists have managed to get as many as about twenty amino acids into a chain, working one at a time, and therefore controlling the order. Even managing twenty, however, is extraordinarily tedious and wasteful besides. The final product represents a small fraction of the original starting materials. Chemists can also begin with a quantity of amino acids and impose conditions that result in the automatic formation of long strings with reasonable rapidity and efficiency. Here, however, there is no way of controlling the arrangement.

To form long strings of amino acids, with a definite microdesign selected in advance, and to do it quickly and efficiently, is simply beyond the power of the chemist.

—Except that it isn't. Basically, the problem of the synthesis of hemoglobin in the test tube has been solved.

The key to the solution of the problem lay in the fact that the chemist has been doing it all along. In fact, so have you and I. For that matter, so has your pet dog.

To put it as flatly as possible, any living cell knows exactly how to synthesize the most complicated proteins. When it synthesizes a particular protein it gets all the amino acids in just the right place, and it manages to construct a complete large-sized protein molecule from a mixture of individual unconnected amino acids in just two seconds!

When a cell stops synthesizing protein, it is dead.

We can start then by asking the question:

How do cells manage to perform, with almost insulting ease, this synthesis of specific proteins, a task which seems so insuperable to the laboratory chemist.

The answer seems to be that the cell has something the chemist hasn't; a blueprint. The blueprint lies in the microdesign of a complicated molecule called a "nucleoprotein." There are two types of nucleoprotein. One is found in the chromosomes within a cell nucleus. The second is found within particles, called "mitochrondria" and "microsomes" within the cytoplasm of a cell.

The nucleoproteins of both varieties supervise the production of certain specific proteins and in this way govern the chemistry of the cell. (How cell chemistry is governed by the nature of the proteins produced in the cell is a possible subject for another article. For the duration of this one you will have to take my word on the matter.)

Obviously, the blueprint must be passed along to new cells as they are formed, and passed along accurately. In order to do this, nucleoproteins must be able to supervise the production of new molecules exactly like themselves—a process called "autoreproduction."

This it does. Just before a cell is

ready to divide, each chromosome in the cell supervises the synthesis of another just like itself. When the cell does divide, there is one of each chromosome in each cell. A new and accurate copy of the old blueprint has been formed for the new cell.

This careful apportionment of chromosome material among cells as they are formed is not in itself sufficient evidence that the nucleoprotein molecule is the sole blueprint, or even a blueprint at all. Perhaps other substances are also auto-reproducing and are the real blueprints but just happen to be evading our notice.

(It is a suspicious fact that nucleoproteins just happen to have the capacity for attaching to themselves colored dyes of certain types. On treatment with those dyes, they become deeply colored and stand out like neon-lit marquees against the colorless background. Conceivably they could, by virtue of this accident, be receiving more than their fair share of attention.)

There is, however, an answer to this objection which arises from the fact that the blueprint for protein manufacture must be passed on not only from cell to cell but from organism to organism. To do this, females produce egg cells and male organisms sperm cells. Both egg and sperm carry within them the blueprint of the respective parent. On union of the two cells, a new organism has been launched with a blueprint of its own that is a half-and-half scramble of that of both parents.

Now the egg cell is a large cell. It can be as large as an ostrich egg --which is one cell!—with a tiny speck of actual life and a vast supply of food. Even the mammalian egg cell which requires very little in the way of food-supply, since the growing embryo is nourished within the mother's body by the mother's food supply, is still pinhead-size and is the largest cell in the mammalian body.

The sperm cell is another sort of thing altogether. It is much tinier than the egg cell and is driven onward by a lashing tail and in a mad dash to find the egg cell and find it fast. It's accent is on speed so it must economize on mass and there is no room within it for excess baggage of any sort. Anything unnecessary is given the heave-ho. To begin with, it carries virtually no food. Nor does it carry anything else that it doesn't need. The only thing it *does* need is the father's share of the blueprint.

So what is in the sperm cell? Chromosomes! Only chromosomes! Virtually nothing but chromosomes!

Yet the male parent contributes just as much to the child's hereditary pattern as does the female, despite the fact that the egg cell contains, in addition to chromosomes, all the manifold paraphernalia of a complete cell, plus a food store.

Obviously, the nucleoprotein of the chromosome is the complete blueprint for protein manufacture and the only blueprint.

Another line of evidence that points to the same conclusion originates from the fact that nucleopro-

teins may also exist outside of cells. They are then called "viruses." Viruses are all simpler than cells in chemistry and structure but some are simpler than others. The larger viruses contain within themselves material other than nucleoprotein, but the smaller viruses seem to be nucleoprotein only.

Yet even the smallest virus has this property: It can invade cells and there multiply. It imposes its own blueprint upon that of the cell it has invaded. It takes over the cell machinery and uses it to duplicate its own structure. In the extreme case, it can do this with complete disregard of the cell's own requirements, stripping it clean and killing it.

Since some viruses contain nothing but nucleoprotein and since no virus is completely without nucleoprotein, once again the only possible conclusion is that it is nucleoprotein that contains the blueprint for protein manufacture.

Answering the question as to how the cell synthesizes specific proteins has thus only faced us with two new questions that force us more deeply into the fundamentals of the subject:

1) How do nucleoproteins supervise the formation of molecules like themselves? How do they auto-reproduce, in other words, and preserve the blueprint?

2) How do nucleoproteins supervise the formation of specific proteins *unlike* themselves, through which they can control the nature of the cell's chemical machinery?

To answer this question, let's poke into the interior of the nucleoprotein molecule. The easiest way to do that is to study small viruses, which are nucleoprotein molecules on the loose and which are not all messed up with non-nucleoprotein material.

The particular virus which has been most studied is one called "tobacco mosaic virus," which infects the leaves of tobacco plants, causing a characteristic mottled appearance. Away from tobacco leaves, this virus shows no signs of life. The only way one can judge whether a certain sample of virus is alive or not is to bring it to the leaves. If the leaves are then infected, the virus is alive. If the leaves remain healthy, the virus is dead.

In this way, one can decide what must be done to a virus to kill it. Study its infectivity before and after.

For instance, the tobacco mosaic virus can be gently teased into two parts of different chemical nature. One part is a protein, like other proteins in general characteristics. The second part is not a protein but something altogether different called a "nucleic acid" with a structure which, at the moment, doesn't concern us.

When a tobacco mosaic virus sample is treated in this way, the two parts have lost infectivity. Both by themselves are dead. If the two parts are mixed, however, about one per cent of the original infectivity returns. Apparently, the nucleic acid rejoins the protein but usually in an incorrect and useless manner. One out of a hundred reunions, however,

go click, click nicely so that the original molecule with its original infectivity is restored.

This certainly made it seem as though the boundary-line between life and nonlife had been crossed in the laboratory. To be sure, the "life" involved was of the simplest sort, and the "nonlife" was only one step removed from it, still the principle remained and it certainly seemed a milestone in biochemistry.

However, there was a catch. Actually, there was a very small residual infectivity remaining in the nucleic acid portion of the molecule. This seemed unimportant at first since it seemed certain that this was only because the nucleic acid portion wasn't quite pure. There was—obviously!—a small quantity of intact virus hanging on.

But then, as no amount of purification of the nucleic acid seemed to remove the small residual infectivity, doubts grew. Was the nucleic acid infective on its own but just having trouble getting into the cell? The nucleic acid from the virus was injected into the cell and, sure enough, there it multiplied.

Apparently, nucleic acid by itself was alive, and in going from nucleoprotein to nucleic acid and back, one was not crossing the boundary line between life and nonlife after all.

But if nucleic acid is alive, why does it need the protein, which by itself is completely noninfective and dead? Why is live nucleic acid plus dead protein so much more infective than live nucleic acid alone?

The answer seems to be that it is the protein portion of the virus which gets the nucleic acid to its destination. (Just as a live man plus a dead automobile can get from one city to the next faster than can a live man alone.)

This shows itself most plainly in the activity of bacteriophage. Bacteriophage is a large complicated virus that infests bacterial cells, and, as the electron microscope clearly shows, it is shaped like a tiny tadpole with a distinct tail.

The protein of the bacteriophage forms a hollow shell on the outside of the virus. Inside the hollow is coiled the nucleic acid molecule.

When a bacteriophage molecule encounters a bacterial cell, there turns out to be something about the structure of the end of the bacteriophage tail which causes it to be attracted strongly to specific spots on the bacterial surface. Clunk, the virus makes contact and sticks.

Once bacteriophage is stuck to bacterium, thanks to the bacteriophage protein, said protein performs a second service. A digestive enzyme in the bacteriophage tail dissolves that portion of the bacterial cell surface with which it is in contact. Now—and this is the key point—the nucleic acid molecule inside the protein pellicle of the virus writhes its way into the bacterium. Only the nucleic acid enters the cell of its victim! The protein portion of the virus remains outside!

Yet once within its victim, the bacteriophage nucleic acid behaves all

on its own like the blueprint in charge. It forces the chemical machinery of the bacterial cell to form more molecules of nucleic acid exactly like the bacteriophage—and *not* like the customary nucleic acid molecules needed by the bacterial cell for its own purposes.

Not only that, but the bacteriophage nucleic acid also forces the bacterial cell machinery to form bacteriophage protein as well. When the process is complete and the sucked-dry bacterial cell dissolves into shreds, there are present hundreds upon hundreds of complete bacteriophage molecules.

Obviously, nucleic acid is blueprint not only for nucleic acid, but for protein as well. So once again, a closer look has increased the number of our questions:

1) How does a molecule of nucleic acid duplicate itself?

2) How does a molecule of nucleic acid bring about the formation of the protein portion of the nucleoprotein molecule?

3) How does a molecule of nucleic acid bring about the formation of proteins other than the protein portion of the nucleoprotein molecule?

Well, let's take a closer look at the nucleic acids. Like the protein molecules, nucleic acid molecules are very large and very complicated. However, the nucleic acid molecules—again like the protein molecules—are made up of connected links, all the links being of similar and of fairly simple structure. In the case of proteins, the building blocks making up the string are the amino acids; in the case of nucleic acids, the building blocks are "nucleotides."

Each individual nucleotide is, in turn, made up of three still simpler portions, which we can call a "phosphate group," a "sugar group," and a "nitrogenous base" group. In each nucleotide, the phosphate group (P) is attached to the sugar group (S) which is, in turn, attached to the nitrogenous base (N). The phosphate group of each nucleotide is also attached, by a second connection, to the sugar group of the neighboring nucleotide. A section of the nucleotide molecule would, therefore, have the schematicized appearance shown in Figure 1.

All down the long line of hundreds upon hundreds of nucleotides making up the molecule, the phosphate groups are the same in each case and so are the sugar groups.* Where the individual nucleotides differ is in the nature of the nitrogenous base they contain. There are, in the main, four different nitrogenous bases to be found here and there in a nucleic acid molecule, which is, therefore, made up of a specific arrangement of four different kinds of nucleotides. (Naturally, a large nucleic acid will contain hundreds of each of the four kinds.)

*In the two varieties of nucleic acid, one in the chromosomes of the cell nucleus and one in the mitochrondria and microsomes of the cell cytoplasm—the exact nature of the sugar group is slightly different. This does not affect the general argument of this article and so I'm ignoring the fact. In any one nucleic acid molecule, the sugar group is, in any case, the same for all the individual nucleotides. (Some viruses, by the way, contain one variety of nucleic acid, some the other, and some both.)

Figure 1—Schematic Representation of the Nucleic Acid Molecule

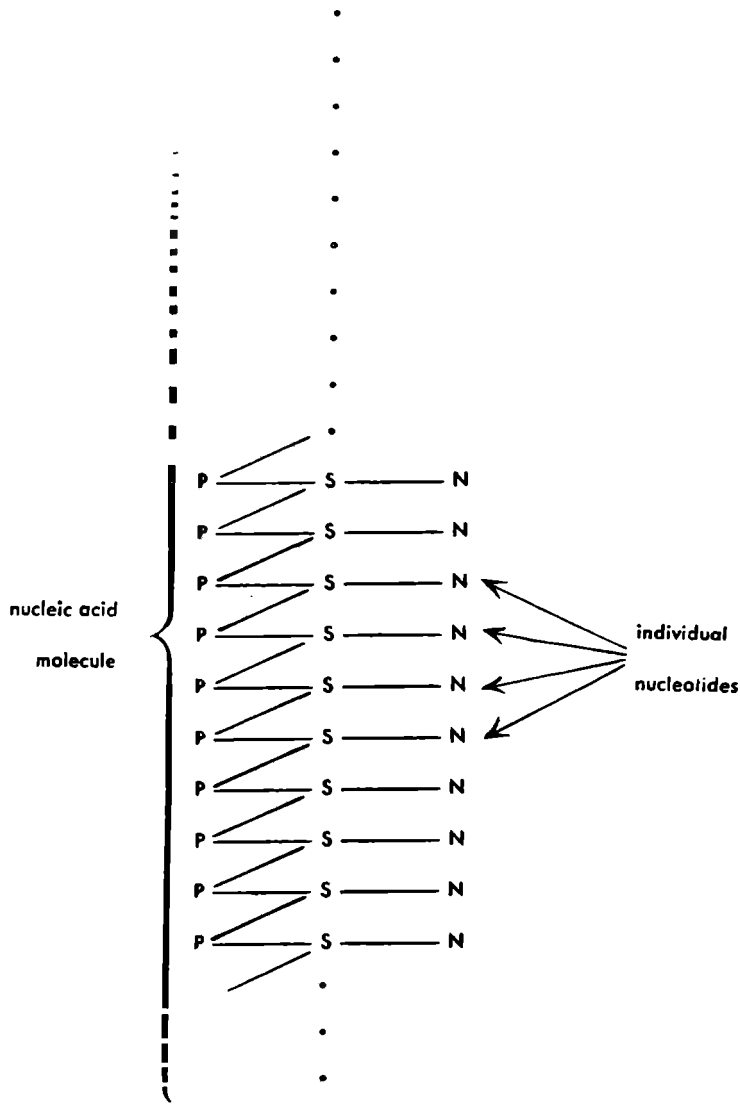
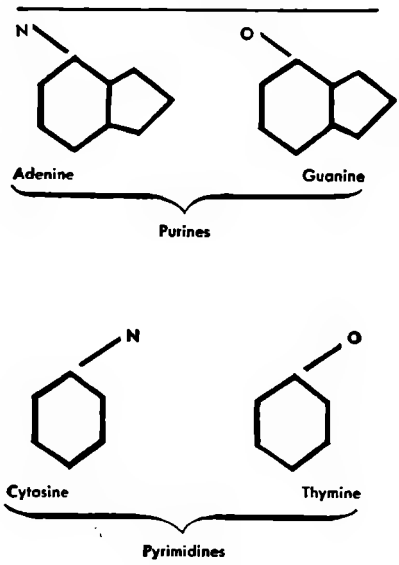


Figure 2—Schematic Representation of the Nitrogenous Bases



The four nitrogenous bases are divided into two classes: "purines" and "pyrimidines." There are two nitrogenous bases in each class. The two purines are "adenine" and "guanine." Their molecules have atoms arranged into a pair of rings which can be schematically represented as a joined pentagon and hexagon. The two differ in that attached to one corner of the hexagon in the adenine molecule is a nitrogen atom (N), while to that same corner in the guanine molecule is an oxygen atom (O). (Both are nevertheless "nitrogenous bases" because each has nitrogen atoms included among the atoms that are arranged in the rings.)

The two pyrimidines are "cytosine" and "thymine," which have smaller molecules than do the purines. The pyrimidines have only enough atoms to be arranged into a single ring which can be represented as a hexagon. Again, the cytosine has a nitrogen atom sticking out of one corner of the ring, where the thymine has an oxygen atom.

The four molecules can now be drawn as shown in Figure 2. The diagrams shown there are not the full chemical formulas, mind you. I have shown enough of the structure as will be useful for my purposes here.

The four nitrogenous bases are distributed along the length of the nucleic acid molecule in a free and easy distribution similar to that of amino acids in a protein molecule. Nevertheless, each particular nucleic acid has its own definite arrangement of these groups. It is this arrangement which is the microdesign of the nucleic acid molecule, perhaps, and which contains within it the blueprint for protein synthesis.

Yet how does this help things? It seems to shift an insoluble problem from the protein to the nucleic acid, and leaves us no better off.

Or does it? Let's see.

As it turns out, nucleic acid occurs in nature—in the interior of the bacteriophage virus, for instance—not as a single string of nucleotides but as a pair of such strings. These are wound about in a helical arrangement—like a spiral staircase, that is—with a common axis.

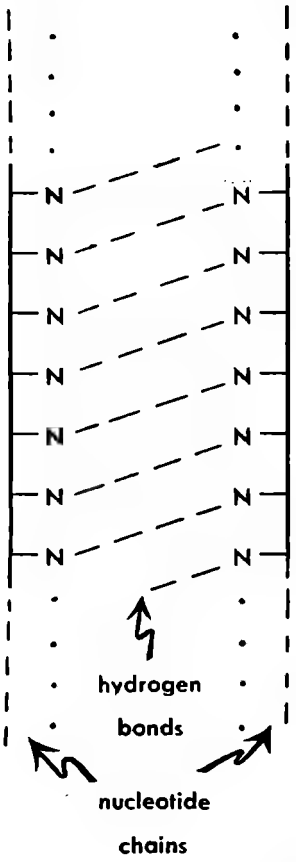
In such a double helix, the phosphate and sugar groups of each nucleotide are on the outside. Facing the central hollow within the helix are the nitrogenous bases of the two nucleotide chains. Opposing nitrogenous bases of the two chains are held together by "hydrogen bonds." The hydrogen bond is a trick of molecular structure that is essential to life—and worth an article of its own some day. It is a weak bond, as chemical bonds go, being only a twentieth as strong as the bonds that usually hold atoms together within a molecule. It is strong enough, even so, to hold the two nucleotide chains together. Yet it is also weak enough to break and allow the two chains to separate on occasion without being unduly stubborn about it.

If the nucleic acid double-helix is imagined as straightened out, the situation would be that shown in Figure 3. Since only the nitrogenous bases interest us at this point, I am leaving out phosphate groups and sugar groups in the figure, since they would be unnecessary distractions. I am drawing the hydrogen bonds slantwise rather than straight across as an arbitrary distortion that will come in handy in a little while.

Now can any one of the nitrogenous bases be hooked to any other, or are there preferred joinings?

The latter is the case. The two nucleotide chains are at a fixed and constant distance from each other down the length of the double helix. If this distance were just right for two pyrimidine molecules to hook together by way of a hydrogen bond, stretching across the gap comfortably, there would be trouble. A pyrimidine would then be unable to attach itself to a purine, with its much wider, double-ring molecule, because there would be no space for the combina-

Figure 3—Schematic Representation of the Nucleic Acid Double Helix



tion between the chains. And there would certainly be no room for two purines to combine. A pyrimidine-pyrimidine hookup, if possible therefore, would simply force the purines out of the picture.

The reverse would be true if a purine could attach itself to a purine and the combination stretched comfortably across the gap between the nucleotide chains. A purine combination with the narrower pyrimidine would not stretch across the gap and a combination of two pyrimidines certainly would not. A purine-purine hookup, if possible therefore, would force the pyrimidines out of the picture.

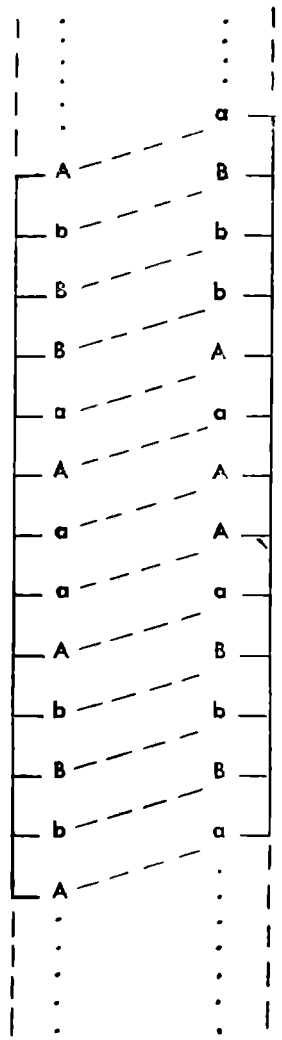
The only situation that would allow for both a gap of constant width between the chains and the full utilization of all four nitrogenous bases would be to have a purine-pyrimidine hookup in each and every case.

In addition to this, it turns out there is another restriction. The hydrogen bond seems to form best between the nitrogen atom sticking out of one ring—or set of rings—and the oxygen atom sticking out of another. What we need then is a nitrogen-purine attached to an oxygen-pyrimidine or an oxygen-purine attached to a nitrogen-pyrimidine.

This gives exactly two nitrogenous base combinations that are possible, as you will see if you refer to Figure 2. These are (1) a combination of adenine and thymine, and (2) a combination of guanine and cytosine.

Now that we have worked out the possible attachments, let's simplify

Figure 4—Schematic Representatio of the Microdesign of Nucleic Acid



matters by calling adenine, *A*, and thymine, *a;* guanine, *B*, and cytosine *b*. Using this system the only combination of nitrogenous bases that are possible are: *A—a; a—A; B—b;* and *b—B*. Now we can prepare Figure 4 —which is an elaboration of Figure 3—in which the two nucleotide chains—*X* and *Y*—are each given an arbitrary arrangement of nitrogenous bases which, however, fit neatly into the permissible combinations only.

Now we are ready to consider a possible answer to the first question involving the nucleic acid—How can it manage to duplicate itself?

Suppose, now, conditions with the cell are such that the double helix of the nucleic acid molecule separates into the two single helical chains, *X* and *Y*. Suppose, further, that each separate chain is surrounded by cell fluid which contains—as it does—a plentiful supply of individual nucleotides, or material out of which nucleotides can be formed on short notice.

These individual nucleotides are always—by blind movement—striking against the single nucleotide chain. If a thymine-containing nucleotide strikes a section of the chain containing an adenine group, it sticks because it fits nicely into the coils of the helix. If it strikes, instead, another thymine or a cytosine, the fit is too loose and it bounces away. If it strikes a guanine, the fit is good but the hydrogen bond must be formed between two oxygens which, for some reason, doesn't happen, and away bounces the thymine again. (Oxygen-oxygen hydrogen bonds, I hastily assure you, are easily formed elsewhere; between water molecules, for instance.)

The net result is that all down the line, a thymine nucleotide (*a*) will only fit to an adenine (*A*) section of the chain. Similarly, only a *b* will adhere to a *B*, only an *A* to an *a* and only a *B* to a *b*. When all the nucleotides are lined up, each to its natural mate, they are combined into a chain by enzyme action—which is another story.

In short, chain *X* just naturally encourages the formation of an adjoining chain just like chain *Y* that left it. Similarly, chain *Y* encourages the formation of an adjoining chain *X*. Each acts as a negative mold for the other. The result is that where one double-helix of nucleic acid existed before, two—each exactly like the first—exist afterward.

One major puzzle is just how the two nucleotide chains manage to separate. On an atomic scale they make up a long and intimate union and it is not easy to see how there could be enough time to get completely loose before starting to autoreproduce. Furthermore, once loose, the individual chains might get twisted and not behave as proper molds.

One attractive theory is that as the chains start separating at one end—and what starts them doing this at just the right time is another puzzle without any answer I have yet heard of—the proper nucleotides start hooking on at once to the loose ends.

The new joinings proceed down the line as separating continues. It is as though you imagined a zipper opening and, as it opened, a new row of teeth joining to the separating halves so that when you completed the opening you found, not one open zipper, but two identical closed zippers.

Occasionally, of course, a nucleotide chain might not reproduce itself perfectly. For instance, *A*—rather than *B* might just happen to wedge itself in next to *b*, and be built into a chain before it could bounce away. At the next separation, the *b* of the first chain would attach itself to a *B* as it should and become perfectly normal again. The interloping *A* of the other chain would however attach itself to an *a*, forming a nucleic acid not quite like any of those that preceded it. This is the molecular-micro-design explanation of what we call a "mutation."

(Of course, if we picture each nucleic acid molecule as being built up —whether perfectly or imperfectly— on the mold of a previous molecule, the question arises as to where the first molecule, the original mold, came from. This is outside the scope of this article but was discussed in another article I wrote called "The Unblind Workings of Chance"— Astounding Science Fiction, April, 1957. I mention it now just to anticipate the inevitable question and to tell you—if you are desperate enough —one place where you can find a possible answer.)

But now we are faced with the second question concerning the nucleic acid: how it manages to supervise formation of the protein portion of the nucleoprotein molecule.

This is a difficult problem. Since the protein structure is altogether different from the nucleic acid structure, it isn't so easy to see how one can serve as the mold for the other. Of course, if there were nineteen different nitrogenous bases involved, we could say: Aha, each nitrogenous base is equivalent—in some mysterious fashion—to one particular amino acid, and the nucleic acid design is converted to a protein design in fashion analogous to the manner in which the numbers from 1 to 26 can be converted to the letters from A to Z.

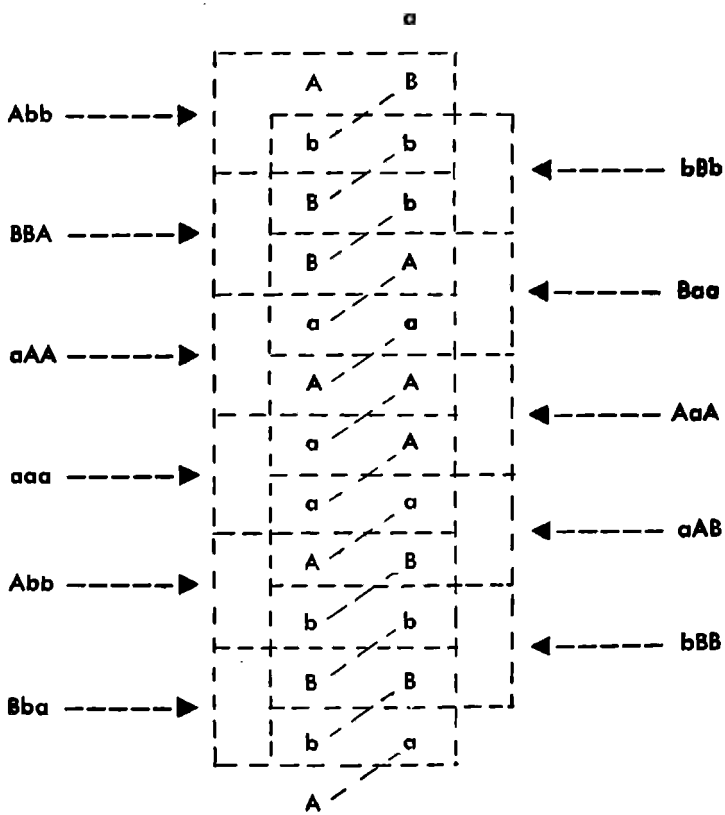
But there are only four different nitrogenous bases, so matters aren't even that simple. The answer would have to lie, perhaps, in an analogy to the operation of the telegraph. In the Morse Code, the twenty-six letters of the alphabet must be represented by only two symbols, the dot and the dash. The solution is to let the letters be represented by distinct groups of dots and dashes.

George Gamow—physicist, mathematician, and popular science-writer —has, in fact, proposed a "Morse Code" for nucleotides. If we group the nitrogenous bases showing in Figure 4 into squares of four, two from each chain, as in Figure 5, we have a number of different combinations.

(In Figure 5, I introduce still further simplification, omitting any representation of the nucleotide chain

Figure 5—Schematic Representation

of Gamow Squares



itself, as an unnecessary distraction. Only the nitrogenous bases and the hydrogen bond connections are shown.)

In each Gamow square—*my* name for them and not Gamow's—two of the bases are connected by a hydrogen bond and are not truly independent. If one of the connected bases is *A*, the other must be *a*, and if one is *B*, the other must be *b*. Only one of this pair is an independent variable and the other is then fixed. Let us, therefore, eliminate one of the two, say the upper right member of each Gamow square.

When this is done, each Gamow square contains a group of three independent letters, and the group in each case is shown in Figure 5 to the side of the corresponding square. Altogether the number of different combinations possible—if we ignore the order in which they appear—is just twenty. These 20 are given in Figure 6.

There is thus a different Gamow square for each of the nineteen amino acids and, in fact, one square left over. (There are certain amino acids other than the nineteen usual ones, I hasten to say, which sometimes appear in proteins. However, there are certain pyrimidines which occasionally replace cytosine in nucleic acids. If there are more than nineteen amino acids to consider, there are also more than twenty Gamow squares that are possible.)

Despite the neatness and general attractiveness of Gamow's theory, there is one difficulty about it which Gamow himself points out. The Gamow squares shown in Figure 5 overlap because the centers of neighboring overlapping squares are just about as far apart as the centers of adjacent amino acids in proteins, so you can imagine one microdesign controlling the other in actual juxtaposition, one-to-one. If you considered Gamow squares to be adjacent but not overlapping—like those with the dotted lines extended to the left, or those with dotted lines extended to the right, in Figure 5—then the centers of neighboring squares are further apart than are the centers of neighboring amino acids in proteins and the necessary control becomes difficult to visualize.

If, however, you must use overlapping Gamow squares as your code, then neighboring squares are not truly independent. Consider the situation in Figure 5. If one square is *aaa*—as one is—then each of the two neighboring squares must include at least one *a*. The overlapping square *cannot* be *BBB* or *Abb* or *bAB*.

If each Gamow square represents a different amino acid, then it would follow that certain combinations of amino acids couldn't exist. Whatever amino acid is represented by *BBB*, for instance, simply could not follow the amino acid represented by *aaa*. This, however, is not in accord with the actual facts. Experience with proteins has already shown us that any amino acid can follow any amino acid. There are no outlawed amino acid neighbors.

Gamow has tried to get around this difficulty by a stratagem which is to me, personally, unconvincing. I'm hoping, though, that some explanation that *is* convincing is offered because I find the Gamow square theory so attractive that I can't help but hope it can be established.

If the first question about nucleic acids seems to be well-answered and if the second question has at least a tentative answer, the third question —about how a nucleic acid can supervise the formation of proteins

other than the protein portion of the nucleoprotein molecule—still leaves us at sea.

The nucleic acid of viruses supervise the formation only of the protein of the virus, so we can gain no information about the third question from them. The nucleic acid in cells, however, must form all the many thousands of different proteins that go into the running of the cell machinery, so an answer to the third question is vital.

Does each different nucleoprotein molecule in the cell form only one kind of protein? Is the number of different nucleoprotein molecules great enough to manage that? Is the protein formed by a nucleoprotein similar to the protein of the nucleoprotein itself; is it a "loosened shell" doing its own job?

Is the working protein of the cell formed by the nucleic acid and protein of the nucleoprotein working together and is it, therefore, different from the protein of the nucleoprotein which is formed by the nucleic acid working alone? Do the two varieties of nucleoprotein—one in the chromosomes of the nucleus and one in the mitochrondria and microsomes of the cytoplasm—have fundamentally different jobs? If so, how and why?

Does each nucleoprotein molecule form more than one different protein molecule, using various restricted portions of itself as a model? (After all, most working proteins of the cell are considerably smaller in size than are the giant nucleoprotein molecules.)

Well, we've got to leave a few problems for the future and these are some of them.

Granted that we are nowhere near the end of the line in probing the problem of autoreproduction and protein synthesis, can we manage to do anything useful with what we already know?

Figure 6—Possible Combinations in the Gamow Squares

AAA	aaA	BBA	bbA	BbA
AAa	aaa	BBa	bba	bAa
AAB	aaB	BBB	bbB	AaB
AAb	aab	BBb	bbb	aBb

I think we can. I think we are reaching the point where we can begin to turn from hunting to herding on a molecular scale.

The human race did just that once before on a microscopic scale. Man—once he became carnivorous—was first a hunter, foraging for what game he could find and starving when he couldn't find it. At some stage, he learned that if he kept certain animals behind fences or under guard and fed them and took care of them, they would breed. Instead of going out to search for animals, he would be presented with animals. The food supply was made several times more secure and human civilization took a giant step forward.

On a molecular scale, however, we are still hunters. If we want insulin, for instance, we have to look for it in its native haunt, the animal pancreas. Those most available in the greatest numbers are the pancreases of slaughtered cattle and swine. However, each steer and each pig has one and only one pancreas so that there is an upper limit to the amount of insulin that can be produced in a given time.

But suppose we must have more insulin. Too bad, we're out of luck!

But if we "tame" the insulin-making mechanism in pancreas cells, what then? What if we isolate the nucleic acid that governs the manufacture of insulin, put it in a test-tube at the right temperature and in the right surroundings and feed it amino acids—those can be prepared by the ton, if necessary. There is then no theoretical reason why we can't have any amount of insulin we want.

Cattle under control will supply us with meat and milk; fowls under control with meat and eggs; nucleic acids under control with insulin or any other desired protein. The principle is the same. We will be herding protein, not hunting it.

A beginning has actually been made at this. Scientists at the California Institute of Technology, under the leadership of R. S. Schweet, used microsomes from immature red cells as their herd. (Immature red cells are in the business of making hemoglobin at a great rate and the nucleic acid in charge of the process is in the microsomes.) The C.I.T. group fed these microsomes the appropriate amino acids and got hemoglobin out of it. (In a way, this solves the put-the-house-back-together problem I cited at the beginning of the article.)

This is not truly synthetic hemoglobin, perhaps, but it will do. It is a remarkable step forward since it involves putting the body's protein blueprints under human control. Analogously, calves are not synthetic but are something more than infant animals found by chance in the forest. The calf, after all, is the result of putting the bull-cow blueprint for calves under human control—or at least under human supervision.

In addition, just as domestic animals can be bred for more milk and eggs, more beef, more tractable disposition, even at the cost of general

survival value in the wild; so domestic nucleic acids can be bred to yield meat protein without skin, bone, gristle and fat. Or valuable hormones or enzymes.

And why not even improve on the natural product?

Is the way really open to the manufacture of proteins that don't occur in Nature? Suppose we deliberately alter a nucleic acid to see what kind of a novel protein it can then build up. (Just as by deliberately alter a nucleic acid to see keys to interbreed, we produce that useful but somewhat artificial animal, the mule.)

There is even indication of that.

Just a few weeks ago, as I write, Drs. V. G. Allfrey and A. E. Mirsky of the Rockefeller Institute have suggested that it is the phosphate group on the nucleic acid that forms the microdesign for protein synthesis. The phosphate group under the conditions prevailing in the human body carries a negative charge. There is thus a long series of negative charges down the line of the nucleotide chain. If the pattern of charge differs subtly from molecule to molecule each could be responsible for a subtly different protein.

Allfrey and Mirsky reached their conclusions by isolating cell nuclei and removing the nucleic acid therefrom. At once the ability of the nucleus to manufacture nucleic acid and protein came to an end. If the nucleic acid—or even nucleic acid from the cytoplasm—were restored, the ability to manufacture protein was restored.

More startling, the nucleic acid could be replaced with a synthetic polymer that resembled the nucleic acid only in having a long-chain molecule with periodic negative charges along the line. With this in the nucleus, protein-manufacture also returned. (It didn't work with synthetic polymers that carried positive charges or no charges.)

I wonder what kind of protein the synthetic polymer produced. I haven't heard yet, and it may take some time for enough to be formed under such circumstances to be isolated and studied.

But the way is open and there is no theoretical reason why there may not be future Luther Burbanks on the molecular scale, designing new proteins shaped for particular jobs that would be better for our purposes than those which Nature has designed, which are intended for her purposes and not necessarily ours.

We have synthetic dyes, synthetic fibers and synthetic plastics, all different from and in some ways better than the equivalents found in Nature. Why not synthetic proteins, too? And I wouldn't be a science-fiction writer if I could resist adding one sentence to round off the entire article—

If synthetic protein, why not new and, in some ways, better synthetic life?

THE END

Illustrated by Summers

THE BARRIER MOMENT

It is usually very difficult to prove what you seek to establish—and, sometimes, in the process you prove the answer to a question you didn't ask!

By WINSTON P. SANDERS

HEN he heard the footsteps, Cohen turned on his heel and growled, "Now what the devil is it?" The jaggedness of the movement and of his voice told him how thin his nerves were worn.

A guard in the door saluted. "I was told to escort this gentleman to see you, colonel. Being as how the project is so near, uh, well, the next phase, sir, General Sanchez thought he'd better see you right away."

He stood aside. Cohen laid down the voltmeter he had been about to plug into a testing circuit. He was a large blond man, still fairly young, who had played football for his technical college before going on to a Ph.D. in physics and an officer's commission. "So?"

A stooped gray figure entered from the hall, leaning on a cane and peering through thick-lensed glasses that sat uneasy on a great beak of nose. "Good Lord!" exploded Cohen. "McMurtrie!"

"Surprised?" The old man advanced, one wisp of a hand outstretched. "Don't see what a professor of philosophy is doing in the precious heart of your Project Robinson, eh?" As they shook, his beady gaze swept the apparatus-packed great room. "Biggest mystery to me is how it gets so drab a name. I suppose you ran out of the romantic ones. Eh? To be expected when every two-bit undertaking, to shoot off this rocket or index that file cabinet, has to be called Project Thus and Operation So. Waste not, want not, say the Gods of the Copybook Headings."

His grumble died out and he took a cheroot from his shabby coat.

Cohen jerked his head at the guard, who departed. The colonel sat down on a lab bench, swinging one leg, and indicated a swivel chair. "Well, make yourself at home, professor," he said. "I wish General Sanchez had told me—"

"Too busy, perhaps. Or more likely, didn't want you raising advance objections. He's as intelligent a man as the government allows him to be." McMurtrie lowered himself, focusing attention on the fifty-foot cylinder which gleamed in a cradle near the center of the room. One panel had been removed so that Cohen could probe its electronic guts. "And that is the time machine."

"Please." Cohen winced. "The Tempotron."

McMurtrie stamped his cane on the concrete floor. "Do you believe an object becomes more scientific when you name it with a hybrid of bad Latin and worse Greek? I say time machine."

Despite weariness and tension, Cohen smiled. He had been McMurtrie's neighbor for some two years now; the Army research project was undertaken in collaboration with the University physics department, and on University grounds. They didn't have much in common. Cohen's wife, a shy gentle girl with a degree in arts, was the only one who could even try to talk McMurtrie's kind of shop. But the professor played a

slashing game of chess, which had often brought him together with Cohen.

"All right, have it your way," said the colonel. "I suppose mainly we're afraid of the headlines, if and when this is finally made public. Tempotron sounds less sensational."

McMurtrie held a wooden match to his cheroot. "Word magic! But how did this project ever start? How long ago?"

"Not quite three years. Certain phenomena were noticed by Gundestrup when he bombarded lithium with super-high-energy mesons in the big accelerator. He's never understood just what happened, for the same experiment had been performed before without such anomalous results." Cohen shrugged. "However, nuclear physics is at least as much an art as a science. Gundestrup's an imaginative fellow, and saw he could explain his data quite simply by assuming that the xi particles formed were thrown backward in time a few microseconds. He devised a special experiment to test his hypothesis, a very simple breadboard circuit. And it worked! I suppose I'd better not go into detail, even if you must have a Q clearance to get in here."

"I wouldn't understand, anyhow," said McMurtrie. "My job is to analyze statements made by men, not squiggles made by electrons." He drew hard on his cigar. "Go on, please. General Sanchez gave me only the barest outline and then referred me to you. This is all so new to me, such a stunning thing—"

"I know," said Cohen. "Even now, two years after I was co-opted, I often catch myself wondering if it can be true."

"Oh, I don't boggle at the idea itself," said McMurtrie. "Philosophers are always coming up with odder ones than time travel. It's adjusting to the fact which is difficult. Continue."

"Gundestrup was getting data for . . . another project. So everything he did was under security from the start. Thank God for that, or we'd be racing the Russians in still another field!"

"Are you certain that you aren't?"

Cohen winced again. "The basic circuits are astonishingly simple," he hurried on, "and not much energy is required. In some ways, the strangest part of this whole affair is that no one ever stumbled on the phenomenon before. In a matter of months, once the project had been set up, we were sending mice hours back. Eeriest sensation: suddenly the cage would appear, maybe right next to itself. Later we'd take the other cage, or the original one, or whatever you call it, strap it on the projector board, throw a switch—and have only one cage again."

"Ever tried not sending the first cage back?"

"Once. For several days. Until one of the boys needed to test a new hookup, absent-mindedly grabbed the extra cage, and projected it back just far enough. Oh, the theory is well worked out by now. If you really

have mulled over time travel, I need only summarize by saying that there are no paradoxes, except for the theoretical possibility of circular causation. And no, we have not yet figured out how to travel into the future. And yes, we have considered the military potentialities, which is why the project has suddenly become so big and urgent."

"I see." McMurtrie scowled. "And yet your longer-range machines have never returned, eh?"

"Exactly," said Cohen. "The longest backward leap we've ever made, successfully, was thirty months. We projected a shell, containing a camera and so on, not into this same laboratory—I told you paradoxes can't happen—but up the hill, in that wooded area where no one ever goes. It stayed for twenty-four hours, photographed certain places in the city beneath it through a telescopic lens —including a house torn down two years ago—and returned on schedule. That was just a few months back."

"But the return trip *is* travel into the future!"

"Not exactly. When a world line doubles back into the past, it reverses direction once more as the projected object rejoins the normal time-flow. This sets up what we call, very loosely, a stress in the continuum. A sort of linkage. The trouble with travel into our future is that we have no, well, no anchor point."

"Your anchor points in the farther past don't seem very helpful."

"No. Which is driving us crazy, inch by inch. There's no reason why we should not send a machine back a billion years. The extra energy required is negligible. The jump-span is determined by the vibration frequency set up in the drive unit. And yet—

"We sent an object back a thousand years. It was to photograph the stars and return, so our astronomers could check the exact date it reached. It never did return, though. We sent others. No luck. We wondered if maybe some Indians weren't destroying them, so we went back a million years. No return. We tried a hundred years back, fifty, ten, five—no return. We've spent half a billion dollars on machines that we never saw again."

McMurtrie regarded his cigar ash. "It's as if you could go no farther back than the date when Gundestrup made his discovery," he mused.

"Yes. But that's absurd! It . . . it . . . no, I won't believe it."

"The human psyche does not feel comfortable with any form of philosophical idealism," said McMurtrie. "I mean, you barbarian, any belief that mind is somehow supreme over matter." He puffed for a moment before adding: "I suppose the responsibility seems too great. Eh?"

"Well, I'm not going to believe the world is all in my head without more data," said Cohen grimly. "I know what *I* think our trouble is."

He left the bench and paced, restless as a bird dog. "You still haven't told me what you're doing here, professor," he said.

"Well," McMurtrie answered,

"you can partly blame your wife. Security or not, she can't help knowing you are involved with something enormous and more than a little sinister. She's frightened for you. She blurted some of her fears out to me, one evening when you were working late and I'd come over. It happens I know General Sanchez. We often argue history, a hobby of both of us. I told him it might be a good idea to let someone with philosophical training take a look at his project. Not intending myself, d' you understand. I didn't want any of your classified information. I only thought that somebody with some familiarity with the larger issues should consider the implications of whatever was being done, not from the scientific viewpoint alone."

"We have sociologists in the project."

"Nor the pseudoscientific viewpoint. Well, Sanchez asked me if I would. I demurred, but he pressed me, and I remembered the look on your wife's face, and here I am. Of course, this all happened a year ago. My clearance came through only yesterday. I have traveled, and corresponded abroad, so of course it took a year to prove I wasn't about to plant a bomb in your lavatory. How many man-years have you spent in that time, sending machines on one-way trips?"

Cohen raised a brow. "So you have the answer?"

McMurtrie spread his hands wide. "I might. As I said before, in my line of work we've been over this ground again and again. Free will versus determinism. The prediction paradox. Physical impossibilities compared to logical impossibilities. Somewhere in all that literature, the answer may lie ready made."

Cohen suppressed a snort. "General Sanchez actually took that seriously? Uh . . . I don't want to hurt your feelings, but you know as well as I do, science is quantitative and philosophy is at best only qualitative. Unless you can prove to me that God or the World Soul or whatever doesn't want time travel beyond a certain date— Huh? What's wrong?"

McMurtrie's waspishness dissolved. All at once he was a very old man, huddled in a chair, and Cohen had never seen anything so bleak as his eyes.

The colonel stepped close, wondering whether to call a doctor. He was waved back. Another moment dragged by before McMurtrie whispered: "Something has occurred to me."

"Not a divine prohibition, I hope?" Cohen had hoped his mockery might put life back in the air, but it fell flat.

"No," said McMurtrie. "Worse. Much more final."

Cohen stood rigid.

"You should send machines to the earliest possible date," said McMurtrie in a slow and rusty voice. "If that barrier moment can be repeatedly verified—"

"Then our project is washed up," said Cohen. "What use is a time ma-

chine that won't put you any further back than August, 1959?"

"Oh, I can still think of applications," said McMurtrie. His mouth twisted into something that might have been a grin. "It's the discovery itself, the fact, which will end an era."

Cohen knotted his fists. The weariness of labor and tension and underlying fear snapped for him: "If you won't come to the point, professor, then tell me about it when I return."

"Eh?" McMurtrie looked up, blinking.

"I'm on my way. After lunch. I was just making a final check."

"You can't!" The words were gasped.

Cohen shrugged. "I should send another man? The piloted Tempotron is my own idea. I pushed it through, persuaded my superiors, oversaw the job. I'm responsible for this baby here, fifty million dollars' worth."

McMurtrie licked his lips. "You're going back . . . a year? Two years?"

"I've been back two years, up on the hill. I stood in a grove of trees and looked down across these buildings and knew myself was working inside one of them. Now it's the long jump. A thousand years."

"But—"

"My guess," said Cohen, and anger doubled in him that his tone should be so hoarse, "is that the high vibration frequency needed to go back so far changes the characteristics of the crystals used. I'm taking a complete set of tools, meters, and spare parts."

McMurtrie struggled to his feet. "No," he said. "Please. You must listen."

"Sure. But whatever you say, I'm going."

"You won't come back. I never thought you were a suicidal type."

Cohen shrugged again.

"Your wife—" said the professor in a beggar's voice.

"I told her last night. That I'd be taking a risk. I don't want to talk any more about that."

McMurtrie nodded with slow care. "Ironic," he said. "What the first human traveler through time needs, is time."

"What?"

"Time to think. Suppose an accident occurred, damage was done, which delayed this expedition even a week. You would have time to contemplate my suggestion, and see that it isn't so wild a notion that you will stake your existence on my being wrong. Eh? Sanchez will also have time to digest the concept and inform Washington. The government will order a delay while a more cautious probing program is undertaken. Eventually, my friend, you will be ordered to cease and desist, and thus released from this compulsion to demonstrate your courage."

Cohen stood aside, for McMurtrie was shuffling toward the machine, head thrust forward like an old and wrinkled tortoise. "So?" he clipped.

McMurtrie's cane jabbed forward, slashing across the exposed circuits.

Cohen heard glass shatter and saw wires yanked loose.

"So you just had an accident," said McMurtrie. "Very clumsy of me. My foot slipped. I apologize."

"You —"

Cohen picked up a monkey wrench and beat it, most softly and methodically, against a table top. After a long while, keeping his back turned to McMurtrie, he said, "O.K. What is it?"

"If you had only had a man with proper philosophical training from the start," sighed the other. "Your glorious, expensive, half-cocked Project Robinson would never — Well. Let me explain."

"You'd better."

"I presume nothing can exist prior to existence itself."

"That sounds . . . reasonable . . . yes."

"Have you never encountered that philosophical question? Even in your own ignorance? It's the oldest chestnut in the book . . . Oldest!" McMurtrie laughed with so startling a tone that Cohen whirled. He looked into a rather terrible grimace.

"The conundrum is this," said McMurtrie. "How can you prove that the entire cosmos did not appear, or was not created, complete with all evidences of a long past history, at some arbitrary date in the past? Such as, say, August, 1959?"

"What?" shouted Cohen.

"Yes," said McMurtrie. "Damn you for answering the question. When will you scientists leave well enough alone?"

THE END

IN TIMES TO COME

Next month Mark Phillips is back with a new tale of FBI Agent Sir Kenneth Malone—"Out Like A Light." Mr. Malone, you may recall, had certain troubles with "That Sweet Little Old Lady" who said she was Queen Elizabeth I of England, being slightly afflicted with battiness, and said she was a telepath . . . which she was.

This time "Sir" Kenneth is involved in the case of the theft of red Cadillacs . . . which, at least, seems somewhat more understandable than tracking down telepathic spies. The real trouble, however, was not that the automobiles disappeared . . . but that the thieves did. Literally. There was the thief, clearly visible . . . then . . . *whoosht!* Out like a light!

Kenneth Malone found tracing a criminal who didn't *leave* the scene of the crime, but *vanished* from it somewhat confusing . . .

THE EDITOR.

(*Continued from page* 82)
through the trees, closing in on him. When he shot two, the others snarled with rage and sank back into the forest. They didn't leave. Instead of being frightened by the deaths they grew even more enraged.

Jason sat with his back to the tree and waited until they came close before he picked them off. With each shot and dying scream the outraged survivors howled the louder. Some of them fought when they met, venting their rage. One stood on his hind legs and raked great strips of bark from a tree. Jason aimed a shot at it, but he was too far away to hit.

There were advantages to having a fever, he realized. Logically he knew he would live only to sunset, or until his gun was empty. Yet the fact didn't bother him greatly. Nothing really mattered. He slumped, relaxed completely, only raising his arm to fire, then letting it drop again. Every few minutes he had to move to look in back of the tree, and kill any of them that were stalking him in the blind spot. He wished dimly that he were leaning against a smaller tree, but it wasn't worth the effort to go to one.

Sometime in the afternoon he fired his last shot. It killed an animal he had allowed to get close. He had noticed he was missing the longer shots. The beast snarled and dropped, the others that were close pulled back and howled in sympathy. One of them exposed himself and Jason pulled the trigger.

There was only a slight click. He tried again, in case it was just a misfire, but there was still only the click. The gun was empty, as was the spare clip pouch at his belt. There were vague memories of reloading, though he couldn't remember how many times he had done it.

This, then, was the end. They had all been right, Pyrrus was a match for him. Though they shouldn't talk. It would kill them all in the end, too. Pyrrans never died in bed. Old Pyrrans never died, they just got et.

Now that he didn't have to force himself to stay alert and hold the gun, the fever took hold. He wanted to sleep and he knew it would be a long sleep. His eyes were almost closed as he watched the wary carnivores slip closer to him. The first one crept close enough to spring, he could see the muscles tensing in its leg.

It leaped. Whirling in midair and falling before it reached him. Blood ran from its gaping mouth and the short shaft of metal projected from the side of his head.

The two men walked out of the brush and looked down at him. Their mere presence seemed to have been enough for the carnivores, because they all vanished.

Grubbers. He had been in such a hurry to reach the city that he had forgotten about the grubbers. It was good that they were here and Jason was very glad they had come. He couldn't talk very well, so he smiled to thank them. But this hurt his lips too much so he went to sleep.

XXIV.

For a strange length of time after that, there were only hazy patches of memory that impressed themselves on Jason. A sense of movement and large beasts around him. Walls, woodsmoke, the murmur of voices. None of it meant very much and he was too tired to care. It was easier and much better just to let go.

"About time," Rhes said. "A couple more days lying there like that and we would have buried you, even if you were still breathing."

Jason blinked at him, trying to focus the face that swam above him. He finally recognized Rhes, and wanted to answer him. But talking only brought on a spell of body-wracking coughing. Someone held a cup to his lips and sweet fluid trickled down his throat. He rested, then tried again.

"How long have I been here?" The voice was thin and sounded far away. Jason had trouble recognizing it for his own.

"Eight days. And why didn't you

listen when I talked to you," Rhes said.

"You should have stayed near the ship when you crashed. Didn't you remember what I said about coming down anywhere on this continent? No matter, too late to worry about that. Next time listen to what I say. Our people moved fast and reached the site of the wreck before dark. They found the broken trees and the spot where the ship had sunk, and at first thought whoever had been in it had drowned. Then one of the dogs found your trail, but lost it again in the swamps during the night. They had a fine time with the mud and the snow and didn't have any luck at all in finding the spoor again. By the next afternoon they were ready to send for more help when they heard your firing. Just made it, from what I hear. Lucky one of them was a talker and could tell the wild dogs to clear out. Would have had to kill them all otherwise, and that's not healthy."

"Thanks for saving my neck," Jason said. "That was closer than I like to come. What happened after? I was sure I was done for, I remember that much. Diagnosed all the symptoms of pneumonia. Guaranteed fatal in my condition without treatment. Looks like you were wrong when you said most of your remedies were useless—they seemed to work well on me."

His voice died off as Rhes shook his head in a slow *no,* lines of worry sharp-cut into his face. Jason looked around and saw Naxa and another man. They had the same deeply unhappy expressions as Rhes.

"What is it?" Jason asked, feeling the trouble. "If your remedies didn't work—what did? Not my medikit. That was empty. I remember losing it or throwing it away."

"You were dying," Rhes said slowly. "We couldn't cure you. Only a junkman medicine machine could do that. We got one from the driver of the food truck."

"But how?" Jason asked, dazed. "You told me the city forbids you medicine. He couldn't give you his own medikit. Not unless he was—"

Rhes nodded and finished the sentence. "Dead. Of course he was dead. I killed him myself, with a great deal of pleasure."

This hit Jason hard. He sagged against the pillows and thought of all those who had died since he had come to Pyrrus. The men who had died to save him, died so he could live, died because of his ideas. It was a burden of guilt that he couldn't bear to think about. Would it stop with Krannon—or would the city people try to avenge his death?

"Don't you realize what that means!" he gasped out the words. "Krannon's death will turn the city against you. There'll be no more supplies. They'll attack you when they can, kill your people—"

"Of course we know that!" Rhes leaned forward, his voice hoarse and intense. "It wasn't an easy decision to come to. We have always had a trading agreement with the junkmen. The trading trucks were inviolate. This

was our last and only link to the galaxy outside and eventual hope of contacting them."

"Yet you broke that link to save me—why?"

"Only you can answer that question completely. There was a great attack on the city and we saw their walls broken, they had to be moved back at one place. At the same time the spaceship was over the ocean, dropping bombs of some kind—the flash was reported. Then the ship returned and *you* left it in a smaller ship. They fired at you but didn't kill you. The little ship wasn't destroyed either, we are starting to raise it now. What does it all mean? We had no way of telling. We only knew it was something vitally important. You were alive, but would obviously die before you could talk. The small ship might be repaired to fly, perhaps that was your plan and that is why you stole it for us. We *couldn't* let you die, not even if it meant all-out war with the city. The situation was explained to all of our people who could be reached by screen and they voted to save you. I killed the junkman for his medicine, then rode two doryms to death to get here in time."

"Now tell us—what does it mean? What is your plan? How will it help us?"

Guilt leaned on Jason and stifled his mouth. A fragment of an ancient legend cut across his mind, about the jona who wrecked the spacer so all in it died, yet he lived. Was that he? Had he wrecked a world? Could he dare admit to these people that he had taken the lifeboat only to save his own life?

The three Pyrrans leaned forward waiting for his words. Jason closed his eyes so he wouldn't see their faces. What could he tell them? If he admitted the truth they would undoubtedly kill him on the spot, considering it only justice. He wasn't fearful for his own life any more but if he died the other deaths would all have been in vain. And there still was a way to end this planetary war. All the facts were available now, it was just a matter of putting them together. If only he wasn't so tired, he could see the solution. It was right there, lurking around a corner in his brain, waiting to be dragged out.

Whatever he did, he couldn't admit the truth now. If he died all hope died. He had to lie to gain time, then find the true solution as soon as he was able. That was all he could do.

"You were right," Jason said haltingly. "The small ship has an interstellar drive in it. Perhaps it can still be saved. Even if it can't there is another way. I can't explain now, but I will tell you when I am rested. Don't worry. The fight is almost over."

They laughed and pounded each other on the back. When they came to shake his hand as well, he closed his eyes and made believe he was asleep. It is very hard to be a hypocrite if you aren't trained for it.

Rhes woke him early the next

morning. "Do you feel well enough to travel?" he asked.

"Depends what you mean by travel," Jason told him. "If you mean under my own power, I doubt if I could get as far as that door."

"You'll be carried," Rhes broke in. "We have a litter swung between two doryms. Not too comfortable, but you'll get there. But only if you think you are well enough to move. We called all the people within riding distance and they are beginning to gather. By this afternoon we will have enough men and doryms to pull the ship out of the swamp."

"I'll come," Jason said, pushing himself to a sitting position. The effort exhausted him, bringing a wave of nausea. Only by leaning his full weight against the wall could he keep from falling back. He sat, propped there, until he heard shouts and the stamping of heavy feet outside, and they came to carry him out.

The trip drained away his small store of energy, and he fell into an exhausted sleep. When he opened his eyes the doryms were standing knee deep in the swamp and the salvage operation had begun. Ropes vanished out of sight in the water while lines of struggling animals and men hauled at them. The beasts bellowed, the men cursed as they slipped and fell. All of the Pyrrans tugging on the lines weren't male, women were there as well. Shorter on the average than the men, they were just as brawny. Their clothing was varied and many-colored, the first touch of decoration Jason had seen on this planet.

Getting the ship up was a heartbreaking job. The mud sucked at it and underwater roots caught on the vanes. Divers plunged time and again into the brown water to cut them free. Progress was incredibly slow, but the work never stopped. Jason's brain was working even slower. The ship would be hauled up eventually—what would he do then? He had to have a new plan by that time, but thinking was impossible work. His thoughts corkscrewed and he had to fight down the rising feeling of panic.

The sun was low when the ship's nose finally appeared above the water. A ragged cheer broke out at first sight of that battered cone of metal and they went ahead with new energy.

Jason was the first one who noticed the dorym weaving towards them. The dogs saw it, of course, and ran out and sniffed. The rider shouted to the dogs and kicked angrily at the sides of his mount. Even at this distance Jason could see the beast's heaving sides and yellow-foam flecked hide. It was barely able to stagger now and the man jumped down, running ahead on foot. He was shouting something as he ran that couldn't be heard above the noise.

There was a single moment when the sounds slacked a bit and the running man's voice could be heard. He was calling the same word over and over again. It sounded like *wait,*

but Jason couldn't be sure. Others had heard him though, and the result was instantaneous. They stopped, unmoving, where they were. Many of those holding the ropes let go of them. Only the quick action of the anchor men kept the ship from sliding back under, dragging the harnessed doryms with it. A wave of silence washed across the swamp in the wake of the running man's shouts. They could be heard clearly now.

"Quake! Quake on the way! South —only safe way is south!"

One by one the ropes dropped back into the water and the Pyrrans turned to wade to solid land. Before they were well started Rhes' voice cracked out.

"Stay at work! Get the ship up, it's our only hope now. I'll talk to Hananas, find out how much time we have."

These solitary people were unused to orders. They stopped and milled about, reason fighting with the urgent desire to run. One by one they stepped back to the ropes as they worked out the sense of Rhes' words. As soon as it was clear the work would continue he turned away.

"What is it? What's happening?" Jason called to him as he ran by.

"It's Hananas," Rhes said, stopping by the litter, waiting for the newcomer to reach him. "He's a quakeman. They know when quakes are coming, before they happen."

Hananas ran up, panting and tired. He was a short man, built like a barrel on stubby legs, a great white beard covering his neck and the top of his chest. Another time Jason might have laughed at his incongruous waddle, but not now. There was a charged difference in the air since the little man had arrived.

"Why didn't . . . you have somebody near a plate. I called all over this area without an answer. Finally . . . had to come myself—"

"How much time do we have?" Rhes cut in. "We have to get that ship up before we pull out."

"Time! Who knows about time!" the graybeard cursed. "Get out or you're dead."

"Calm down, Han," Rhes said in a quieter voice, taking the oldster's arms in both his hands. "You know what we're doing here—and how much depends on getting the ship up. Now how does it feel? This going to be a fast one or a slow one?"

"Fast. Faster than anything I felt in a long time. She's starting far away though, if you had a plate here I bet Mach or someone else up near the firelands would be reporting new eruptions. It's on the way and, if we don't get out soon, we're not getting out t'all."

There was a burble of water as the ship was hauled out a bit farther. No one talked now and there was a fierce urgency in their movements. Jason still wasn't sure exactly what had happened.

"Don't shoot me for a foreigner," he said, "but just what is wrong? Are you expecting earthquakes here, are you sure?"

"Sure!" Hananas screeched. "Of course I'm sure. If I wasn't sure I wouldn't be a quakeman. It's on the way."

"There's no doubt of that," Rhes added. "I don't know how you can tell on your planet when quakes or vulcanism are going to start, machines maybe. We have nothing like that. But quakemen, like Hananas here, always know about them before they happen. If the word can be passed fast enough, we get away. The quake is coming all right, the only thing in doubt is how much time we have."

The work went on and there was a good chance they would die long before it was finished. All for nothing. The only way Jason could get them to stop would be to admit the ship was useless. He would be killed then and the grubber chances would die with him. He chewed his lip as the sun set and the work continued by torchlight.

Hananas paced around, grumbling under his breath, halting only to glance at the northern horizon. The people felt his restlessness and transmitted it to the animals. Dogfights broke out and the doryms pulled reluctantly at their harnesses. With each passing second their chances grew slimmer and Jason searched desperately for a way out of the trap of his own constructing.

"Look—" someone said, and they all turned. The sky to the north was lit with a red light. There was a rumble in the ground that was felt more than heard. The surface of the water blurred, then broke into patterns of tiny waves. Jason turned away from the light, looking at the water and the ship. It was higher now, the top of the stern exposed. There was a gaping hole here, blasted through the metal by the spaceship's guns.

"Rhes," he called, his words jammed together in the rush to get them out. "Look at the ship, at the hole blasted in her stern. I landed on the rockets and didn't know how badly she was hit. But the guns hit the star drive!"

Rhes gaped at him unbelievingly as he went on. Improvising, playing by ear, trying to manufacture lies that rang of the truth.

"I watched them install the drive—it's an auxiliary to the other engines. It was bolted to the hull right there. It's gone now, blown up. The boat will never leave this planet, much less go to another star."

He couldn't look Rhes in the eyes after that. He sank back into the furs that had been propped behind him, feeling the weakness even more. Rhes was silent and Jason couldn't tell if his story had been believed. Only when the Pyrran bent and slashed the nearest rope did he know he had won.

The word passed from man to man and the ropes were cut silently. Behind them the ship they had labored so hard over, sank back into the water. None of them watched. Each was locked in his own world of thought as they formed up to leave. As soon as the doryms were saddled and

packed they started out, Hananas leading the way. Within minutes they were all moving, a single file that vanished into the darkness.

Jason's litter had to be left behind, it would have been smashed to pieces in the night march. Rhes pulled him up into the saddle before him, locking his body into place with a steel-hard arm. The trek continued.

When they left the swamp they changed directions sharply. A little later Jason knew why, when the southern sky exploded. Flames lit the scene brightly, ashes sifted down and hot lumps of rock crashed into the trees. They steamed when they hit, and if it hadn't been for the earlier rain they would have been faced with a forest fire as well.

Something large loomed up next to the line of march, and when they crossed an open space Jason looked at it in the reflected light from the sky.

"Rhes—" he choked, pointing. Rhes looked at the great beast moving next to them, shaggy body and twisted horns as high as their shoulders, then looked away. He wasn't frightened or apparently interested. Jason looked around then and began to understand.

All of the fleeing animals made no sound, that's why he hadn't noticed them before. But on both sides dark forms ran between the trees. Some he recognized, most of them he didn't. For a few minutes a pack of wild dogs ran near them, even mingling with the domesticated dogs. No notice was taken. Flying things flapped overhead. Under the greater threat of the volcanoes all other battles were forgotten. Life respected life. A herd of fat, piglike beasts with curling tusks, blundered through the line. The doryms slowed, picking their steps carefuly so they wouldn't step on them. Smaller animals sometimes clung to the backs of the bigger ones, riding untouched a while, before they leaped off.

Pounded mercilessly by the saddle, Jason fell wearily into a light sleep. It was shot through with dreams of the rushing animals, hurrying on forever in silence. With his eyes open or shut he saw the same endless stream of beasts.

It all meant something, and he frowned as he tried to think what. Animals running, Pyrran animals.

He sat bolt upright suddenly, wide awake, staring down in comprehension.

"What is it?" Rhes asked.

"Go on," Jason said. "Get us out of this, and get us out safely. I told you the lifeboat wasn't the only answer. I know how your people can get what they want—end the war now. There *is* a way, and I know how it can be done."

XXV.

There were few coherent memories of the ride. Some things stood out sharply like the spaceship-sized lump of burning scoria that had plunged into a lake near them, showering the line with hot drops of water. But

mostly it was just a seemingly endless ride, with Jason still too weak to care much about it. By dawn the danger area was behind them and the march had slowed to a walk. The animals had vanished as the quake was left behind, going their own ways, still in silent armistice.

The peace of mutually shared danger was over, Jason found that out when they stopped to rest and eat. He and Rhes went to sit on the soft grass, near a fallen tree. A wild dog had arrived there first. It lay under the log, muscles tensed, the ruddy morning light striking a red glint from its eyes. Rhes faced it, not three meters away, without moving a muscle. He made no attempt to reach one of his weapons or to call for help. Jason stood still as well, hoping the Pyrran knew what he was doing.

With no warning at all the dog sprang straight at them. Jason fell backward as Rhes pushed him aside. The Pyrran dropped at the same time —only now his hand held the long knife, yanked from the sheath strapped to his thigh. With unseen speed the knife came up, the dog twisted in midair, trying to bite it. Instead it sank in behind the dog's forelegs, the beast's own weight tearing a deadly gaping wound the length of its body. It was still alive when it hit the ground, but Rhes was astraddle it, pulling back the bony-plated head to cut the soft throat underneath.

The Pyrran carefully cleaned his knife on the dead animal's fur, then returned it to the sheath. "They're usually no trouble," he said quietly, "but it was excited. Probably lost the rest of the pack in the quake." His actions were the direct opposite of the city Pyrrans. He had not looked for trouble nor started the fight. Instead he had avoided it as long as he could. But when the beast charged it had been neatly and efficiently dispatched. Now, instead of gloating over his victory, he seemed troubled over an unnecessary death.

It made sense. Everything on Pyrrus made sense. Now he knew how the deadly planetary battle had started— and he knew how it could be ended. All the deaths had *not* been in vain. Each one had helped him along the road a little more towards the final destination. There was just one final thing to be done.

Rhes was watching him now, and he knew they shared the same thoughts. "Explain yourself," Rhes said. "What did you mean when you said we could wipe out the junkmen and get our freedom?"

Jason didn't bother to correct the misquote, it was best they consider him a hundred per cent on their side.

"Get the others together and I'll tell you. I particularly want to see Naxa and any other talkers who are here."

They gathered quickly when the word was passed. All of them knew that the junkman had been killed to save this off-worlder, that their hope of salvation lay with him. Jason looked at the crowd of faces turned toward him and reached for the right words to tell them what had to be

done. It didn't help to know that many of them would be killed doing it.

"The small star ship can't be used," he said. "You all saw that it was ruined beyond repair. But that was the easy way out. The hard way is still left. Though some of you may die, in the long run it will be the best solution."

"We are going to invade the city,

break through the perimeter. I know how it can be done . . ."

A mutter of sound spread across the crowd. Some of them looked excited, happy with the thought of killing their hereditary enemies. Others stared at Jason as if he were mad. A few were dazed at the magnitude of the thought, this carrying of the battle to the stronghold of the heavily armed enemy. They quieted when Jason raised his hand.

"I know it sounds impossible," he said. "But let me explain. Something must be done—and now is the time to do it. The situation can only get worse from now on. The city Pyrr . . . the junkmen can get along without your food, their concentrates taste awful but they sustain life. But they are going to turn against you in every way they can. No more metals for your tools or replacements for your electronic equipment. Their hatred will probably make them seek out your farms and destroy them from the ship. All of this won't be comfortable —and there will be worse to come. In the city they are losing their war against this planet. Each year there are less of them, and some day they will all be dead. Knowing how they feel I am sure they will destroy their ship first, and the entire planet as well, if that is possible."

"How can we stop them?" someone called out.

"By hitting *now*," Jason answered. "I know all the details of the city and I know how the defenses are set up. Their perimeter is designed to

protect them from animal life, but we could break through it if we were really determined."

"What good would that do?" Rhes snapped. "We crack the perimeter and they draw back—then counter-attack in force. How can we stand against their weapons?"

"We won't have to. Their spaceport touches the perimeter, and I know the exact spot where the ship stands. That is the place where we will break through. There is no formal guard on the ship and only a few people in the area. We will capture the ship. Whether we can fly it or not is unimportant. Who controls the ship controls Pyrrus. Once there we threaten to destroy it if they don't meet our terms. They have the choice of mass suicide or co-operation. I hope they have the brains to co-operate."

His words shocked them into silence for an instant, then they surged into a wave of sound. There was no agreement, just excitement, and Rhes finally brought them to order.

"Quiet!" he shouted. "Wait until Jason finishes before you decide. We still haven't heard how this proposed invasion is to be accomplished."

"The plan I have depends on the talkers," Jason said. "Is Naxa there?" He waited until the fur-wrapped man had pushed to the front. "I want to know more about the talkers, Naxa. I know you can speak to doryms and the dogs here—but what about the wild animals? Can you make them do what you want?"

"They're animals . . . course we can talk t'them. Th'more talkers, th'more power. Make 'em do just what we want."

"Then the attack will work," Jason said excitedly. "Could you get your talkers all on one side of the city—the opposite side from the spaceport—and stir the animals up? Make them attack the perimeter?"

"Could we!" Naxa shouted, carried away by the idea. "We'd bring in animals from all over, start th' biggest attack they ev'r saw!"

"Then that's it. Your talkers will launch the attack on the far side of the perimeter. If you keep out of sight, the guards will have no idea that it is anything more than an animal attack. I've seen how they work. As an attack mounts they call for reserves inside the city and drain men away from the other parts of the perimeter. At the height of the battle, when they have all their forces committed across the city, I'll lead the attack that will break through and capture the ship. That's the plan and it's going to work."

Jason sat down then, half fell down, drained of strength. He lay and listened as the debate went back and forth, Rhes ordering it and keeping it going. Difficulties were raised and eliminated. No one could find a basic fault with the plan. There were plenty of flaws in it, things that might go wrong, but Jason didn't mention them. These people wanted his idea to work and they were going to make it work.

It finally broke up and they moved away. Rhes came over to Jason.

"The basics are settled," he said. "All here are in agreement. They are spreading the word by messenger to all the talkers. The talkers are the heart of the attack, and the more we have, the better it will go off. We don't dare use the screens to call them, there is a good chance that the junkmen can intercept our messages. It will take five days before we are ready to go ahead."

"I'll need all of that time if I'm to be any good," Jason said. "Now let's get some rest."

XXVI.

"It's a strange feeling," Jason said. "I've never really seen the perimeter from this side before. Ugly is about the only word for it."

He lay on his stomach next to Rhes, looking through a screen of leaves, downhill towards the perimeter. They were both wrapped in heavy furs, in spite of the midday heat, with thick leggings and leather gauntlets to protect their hands. The gravity and the heat were already making Jason dizzy, but he forced himself to ignore this.

Ahead, on the far side of a burnt corridor, stood the perimeter. A high wall, of varying height and texture, seemingly made of everything in the world. It was impossible to tell what it had originally been constructed of. Generations of attackers had bruised, broken, and undermined it. Repairs had been quickly made, patches thrust roughly into place and fixed there. Crude masonry crumbled and gave way to a rat's nest of woven timbers. This overlapped a length of pitted metal, large plates riveted together. Even this metal had been eaten through and bursting sandbags spilled out of a jagged hole. Over the surface of the wall detector wires and charged cables looped and hung. At odd intervals automatic flame-throwers thrust their nozzles over the wall above and swept the base of the wall clear of any life that might have come close.

"Those flame things can cause us trouble," Rhes said, "That one covers the area where you want to break in."

"It'll be no problem," Jason assured him. "It may look like it is firing a random pattern, but it's really not. It varies a simple sweep just enough to fool an animal, but was never meant to keep men out. Look for yourself. It fires at regularly repeated two, four, three and one minute intervals."

They crawled back to the hollow where Naxa and the others waited for them. There were only thirty men in the party. What they had to do could only be done with a fast, light force. Their strongest weapon was surprise. Once that was gone their other weapons wouldn't hold out for seconds against the city guns. Everyone looked uncomfortable in the fur and leather wrappings, and some of the men had loosened them to cool off.

"Wrap up," Jason ordered. "None of you have been this close to the perimeter before and you don't understand how deadly it is here. Naxa is keeping the larger animals away and you all can handle the smaller ones.

That isn't the danger. Every thorn is poisoned, and even the blades of grass carry a deadly sting. Watch out for insects of any kind and once we start moving breathe only through the wet cloths."

"He's right," Naxa snorted. "N'ver been closer'n this m'self. Death, death up by that wall. Do like 'e says."

They could only wait then, honing down already needle-sharp crossbow bolts, and glancing up at the slowly moving sun. Only Naxa didn't share the unrest. He sat, eyes unfocused, feeling the movement of animal life in the jungle around them.

"On the way," he said. "Biggest thing I 'ver heard. Not a beast 'tween here and the mountains, ain't howlin' 'is lungs out, runnin' towards the city."

Jason was aware of part of it. A tension in the air and a wave of intensified anger and hatred. It would work, he knew, if they could only keep the attack confined to a small area. The talkers had seemed sure of it. They had stalked out quietly that morning, a thin line of ragged men, moving out in a mental sweep that would round up the Pyrran life and send it charging against the city.

"They hit!" Naxa said suddenly.

The men were on their feet now, staring in the direction of the city. Jason had felt the twist as the attack had been driven home, and knew that this was it. There was the sound of shots and a heavy booming far away. Thin streamers of smoke began to blow above the treetops.

"Let's get into position," Rhes said.

Around them the jungle howled with an echo of hatred. The half-sentient plants writhed and the air was thick with small flying things. Naxa sweated and mumbled as he turned back the animals that crashed towards them. By the time they reached the last screen of foliage before the burned out area, they had lost four men. One had been stung by an insect, Jason got the medikit to him in time, but he was so sick he had to turn back. The other three were bitten or scratched and treatment came too late. Their swollen, twisted bodies were left behind on the trail.

"Dam' beasts hurt m'head," Naxa muttered. "When we go in?"

"Not yet," Rhes said. "We wait for the signal."

One of the men carried the radio. He sat it down carefully, then threw the aerial over a branch. The set was shielded so no radiation leaked out to give them away. It was turned on, but only a hiss of atmospheric static came from the speaker.

"We could have timed it—" Rhes said.

"No we couldn't," Jason told him. "Not accurately. We want to hit that wall at the height of the attack, when our chances are best. Even if they hear the message it won't mean a thing to them inside. And a few minutes later it won't matter."

The sound from the speaker changed. A voice spoke a short sentence, then cut off.

"Bring me three barrels of flour."

"Let's go," Rhes urged as he started forward.

"Wait," Jason said, taking him by the arm. "I'm timing the flame thrower. It's due in . . . *there*!" A blast of fire sprayed the ground, then turned off. "We have four minutes to the next one—we hit the long period!"

They ran, stumbling in the soft ashes, tripping over charred bones and rusted metal. Two men grabbed Jason under the arm and half-carried him across the ground. It hadn't been planned that way, but it saved precious seconds. They dropped him against the wall and he fumbled out the bombs he had made. The charges from Krannon's gun, taken when he was killed, had been hooked together with a firing circuit. All the moves had been rehearsed carefully and they went smoothly now.

Jason had picked the metal wall as being the best spot to break in. It offered the most resistance to the native life, so the chances were it wouldn't be reinforced with sandbags or fill, the way other parts of the wall were. If he was wrong, they were all dead.

The first men had slapped their wads of sticky congealed sap against the wall. Jason pressed the charges into them and they stuck, a roughly rectangular pattern as high as a man. While he did this the detonating wire was run out to its length and the raiders pressed back against the base of the wall. Jason stumbled through the ashes to the detonator, fell on it and pressed the switch at the same time.

Behind him a thundering bang shook the wall and red flame burst out. Rhes was the first one there, pulling at the twisted and smoking metal with his gloved hands. Others grabbed on and bent the jagged pieces aside. The hole was filled with smoke and nothing was visible through it. Jason dived into the opening, rolled on a heap of rubble and smacked into something solid. When he blinked the smoke from his eyes he looked around him.

He was inside the city.

The others poured through now, picking him up as they charged in so he wouldn't be trampled underfoot. Someone spotted the spaceship and they ran that way.

A man ran around the corner of a building towards them. His Pyrran reflexes sent him springing into the safety of a doorway the same moment he saw the invaders. But they were Pyrrans, too. The man slumped slowly back onto the street, three metal bolts sticking out of his body. They ran on without stopping, running between the low storehouses. The ship stood ahead.

Someone had reached it ahead of them, they could see the outer hatch slowly grinding shut. A hail of bolts from the bows crashed into it with no effect.

"Keep going!" Jason shouted. "Get next to the hull before he reaches the guns."

This time three men didn't make it. The rest of them were under the belly

of the ship when every gun let go at once. Most of them were aimed away from the ship, still the scream of shells and electric discharges was earshattering. The three men still in the open dissolved under the fire. Whoever was inside the ship had hit all the gun trips at once, both to knock out the attackers and summon aid. He would be on the screen now, calling for help. Their time was running out.

Jason reached up and tried to open the hatch, while the others watched. It was locked from the inside. One of the men brushed him aside and pulled at the inset handle. It broke off in his hand but the hatch remained closed.

The big guns had stopped now and they could hear again.

"Did anyone get the gun from that dead man?" he asked. "It would blow this thing open."

"No," Rhes said, "we didn't stop."

Before the words were out of his mouth two men were running back towards the buildings, angling away from each other. The ship's guns roared again, a string of explosions cut across one man. Before they could change direction and find the other man he had reached the buildings.

He returned quickly, darting into the open to throw the gun to them. Before he could dive back to safety the shells caught him.

Jason grabbed up the gun as it skidded almost to his feet. They heard the sound of wide open truck turbines screaming towards them as he blasted the lock. The mechanism sighed and the hatch sagged open. They were all through the air lock before the first truck appeared. Naxa stayed behind with the gun, to hold the lock until they could take the control room.

Everyone climbed faster than Jason, once he had pointed them the way, so the battle was over when he got there. The single city Pyrran looked like a pin-cushion. One of the techs had found the gun controls and was shooting wildly, the sheer quantity of his fire driving the trucks back.

"Someone get on the radio and tell the talkers to call the attack off," Jason said. He found the communications screen and snapped it on. Kerk's wide-eyed face stared at him from the screen.

"*You!*" Kerk said, breathing the word like a curse.

"Yes, it's me," Jason answered. He talked without looking up, while his hands were busy at the control board. "Listen to me, Kerk—and don't doubt anything I say. I may not know how to fly one of these ships, but I do know how to blow them up. Do you hear that sound?" He flipped over a switch and the faraway whine of a pump droned faintly. "That's the main fuel pump. If I let it run—which I won't right now—it could quickly fill the drive chamber with raw fuel. Pour in so much that it would run out of the stern tubes. Then what do you think would happen to your one and only spacer if I pressed the firing button? I'm not asking you what would happen to me, since you don't care—but you need this ship the way you need life itself."

There was only silence in the cabin now, the men who had won the ship turned to face him. Kerk's voice grated loudly through the room.

"What do you want, Jason—what are you trying to do? Why did you lead those animals in here . . ." His voice cracked and broke as anger choked him and spilled over.

"Watch your tongue, Kerk," Jason said with soft menace. "These *men* you are talking about are the only ones on Pyrrus who have a spaceship. If you want them to share it with you, you had better learn to talk nicely. Now come over here at once —and bring Brucco and Meta." Jason looked at the older man's florid and swollen face and felt a measure of sympathy. "Don't look so unhappy, it's not the end of the world. In fact, it might be the beginning of one. And another thing, leave this channel open when you go. Have it hooked into every screen in the city so everyone can see what happens here. Make sure it's taped too, for replay."

Kerk started to say something, but changed his mind before he did. He left the screen, but the set stayed alive. Carrying the scene in the control room to the entire city.

XXVII.

The fight was over. It had ended so quickly the fact hadn't really sunk in yet. Rhes rubbed his hand against the gleaming metal of the control console, letting the reality of touch convince him. The other men milled about, looking out through the viewscreens or soaking in the mechanical strangeness of the room.

Jason was physically exhausted, but he couldn't let it show. He opened the pilot's medbox and dug through it until he found the stimulants. Three of the little gold pills washed the fatigue from his body, and he could think clearly again.

"Listen to me," he shouted. "The fight's not over yet. They'll try anything to take this ship back and we have to be ready. I want one of the techs to go over these boards until he finds the lock controls. Make sure all the air locks and ports are sealed. Send men to check them if necessary. Turn on all the screens to scan in every direction, so no one can get near the ship. We'll need a guard in the engine room, my control could be cut if they broke in there. And there had better be a room-by-room search of the ship, in case someone else is locked in with us."

The men had something to do now and felt relieved. Rhes split them up into groups and set them to work. Jason stayed at the controls, his hand next to the pump switch. The battle wasn't over yet.

"There's a truck coming," Rhes called, "going slow."

"Should I blast it?" the man at the gun controls asked.

"Hold your fire," Jason said, "until we can see who it is. If it's the people I sent for, let them through."

As the truck came on slowly, the gunner tracked it with his sights. There was a driver and three passen-

gers. Jason waited until he was positive who they were.

"Those are the ones," he said. "Stop them at the lock, Rhes, make them come in one at a time. Take their guns as they enter, then strip them of *all* their equipment. There is no way of telling what could be a concealed weapon. Be specially careful of Brucco—he's the thin one with a face like an ax edge—make sure you strip him clean. He's a specialist in weapons and survival. And bring the driver too, we don't want him reporting back about the broken air lock or the state of our guns."

Waiting was hard. His hand stayed next to the pump switch, even though he knew he could never use it. Just as long as the others thought he would.

There were stampings and muttered curses in the corridor; the prisoners were pushed in. Jason had one look at their deadly expressions and clenched fists before he called to Rhes.

"Keep them against the wall and watch them. Bowmen keep your weapons up." He looked at the people who had once been his friends and who now swam in hatred for him. Meta, Kerk, Brucco. The driver was Skop, the man Kerk had once appointed to guard him. He looked ready to explode now that the roles had been reversed.

"Pay close attention," Jason said, "because your lives depend upon it. Keep your backs to the wall and don't attempt to come any closer to me than you are now. If you do, you will be shot instantly. If we were alone, any one of you could undoubtedly reach me before I threw this switch. But we're not. You have Pyrran reflexes and muscles—but so do the bowmen. Don't gamble. Because it won't be a gamble. It will be suicide. I'm telling you this for your own protection. So we can talk peacefully without one of you losing his temper and suddenly getting shot. *There is no way out of this.* You are going to be forced to listen to everything I say. You can't escape or kill me. The war is over."

"And we lost—and all because of you . . . you *traitor*!" Meta snarled.

"Wrong on both counts," Jason said blandly. "I'm not a traitor because I owe my allegiance to all men on this planet, both inside the perimeter and out. I never pretended differently. As to losing—why you haven't lost anything. In fact you've won. Won your war against this planet, if you will only hear me out." He turned to Rhes, who was frowning in angry puzzlement. "Of course your people have won also, Rhes. No more war with the city, you'll get medicine, off-planet contact—everything you want."

"Pardon me for being cynical," Rhes said, "but you're promising the best of all possible worlds for everyone. That will be a little hard to deliver when our interests are opposed so."

"You strike through to the heart of the matter," Jason said. "Thank you. This mess will be settled by seeing that everyone's interests are not opposed. Peace between the city and farms, with an end to the useless war

you have been fighting. Peace between mankind and the Pyrran life forms—because that particular war is at the bottom of all your troubles."

"The man's mad," Kerk said.

"Perhaps. You'll judge that after you hear me out. I'm going to tell you the history of this planet, because that is where both the trouble and the solution lie.

"When the settlers landed on Pyrrus three hundred years ago they missed the one important thing about this planet, the factor that makes it different from any other planet in the galaxy. They can't be blamed for the oversight, they had enough other things to worry about. The gravity was about the only thing familiar to them, the rest of the environment was a shocking change from the climate-controlled industrial world they had left. Storms, vulcanism, floods, earthquakes—it was enough to drive them insane, and I'm sure many of them did go mad. The animal and insect life was a constant annoyance, nothing at all like the few harmless and protected species they had known. I'm sure they never realized that the Pyrran life was telepathic as well—"

"That again!" Brucco snapped. "True or not, it is of no importance. I was tempted to agree with your theory of psionic controlled attack on us, but the deadly fiasco you staged proved that theory wrong."

"I agree," Jason answered. "I was completely mistaken when I thought some outside agency directed the attack on the city with psionic control. It seemed a logical theory at the time and the evidence pointed that way. The expedition to the island *was* a deadly fiasco—only don't forget that attack was the direct opposite of what I wanted to have done. If I had gone into the cave myself none of the deaths would have been necessary. I think it would have been discovered that the plant creatures were nothing more than an advanced life form with unusual psi ability. They simply resonated strongly to the psionic attack on the city. I had the idea backwards thinking they instigated the battle. We'll never know the truth, though, because they are destroyed. But their deaths did prove one thing. It allows us to find the real culprits, the creatures who are leading, directing and inspiring the war against the city."

"*Who?*" Kerk breathed the question, rather than spoke it.

"Why *you* of course," Jason told him. "Not you alone, but all of your people in the city. Perhaps you don't like this war. However you are responsible for it, and keep it going."

Jason had to force back a smile as he looked at their dumfounded expressions. He had to prove his point quickly, before even his allies began to think him insane.

"Here is how it works. I said Pyrran life was telepathic—and I meant all life. Every single insect, plant and animal. At one time in this planet's violent history these psionic mutations proved to be survival types. They existed when other species died, and in the end I'm sure they co-operated in wiping out the last survivors of the

non-psi strains. Co-operation is the key word here. Because while they still competed against each other under normal conditions, they worked together against anything that threatened them as a whole. When a natural upheaval or a tidal wave threatened them, they fled from it in harmony.

"You can see a milder form of this same behavior on any planet that is subject to forest fires. But here, mutual survival was carried to an extreme because of the violent conditions. Perhaps some of the life forms even developed precognition like the human quakemen. With this advance warning the larger beasts fled. The smaller ones developed seeds, or burrs or eggs, that could be carried to safety by the wind or in the animals' fur, thus insuring racial survival. I know this is true, because I watched it myself when we were escaping a quake."

"Admitted—all your points admitted," Brucco shouted. "But what does it have to do with *us*? So all the animals run away together, what does that have to do with the war?"

"They do more than run away together," Jason told him. "They work together against any natural disaster that threatens them all. Some day I'm sure, ecologists will go into raptures over the complex adjustments that occur here in the advent of blizzards, floods, fires and other disasters. There is only one reaction we really care about now, though. That's the one directed towards the city people Don't you realize yet—they treat you all as another natural disaster!

"We'll never know exactly how it

came about, though there is a clue in that diary I found, dating from the first days on this planet. It said that a forest fire seemed to have driven new species towards the settlers. Those weren't new beasts at all—just old ones with new attitudes. Can't you just imagine how those protected, over-civilized settlers acted when faced with a forest fire? They panicked of course. If the settlers were in the path of the fire, the animals must have rushed right through their camp. Their reaction would undoubtedly have been to shoot the fleeing creatures down.

"When they did that they classified themselves as a natural disaster. Disasters take any form. Bipeds with guns could easily be included in the category. The Pyrran animals attacked, were shot, and the war began. The survivors kept attacking and informed all the life forms what the fight was about. The radioactivity of this planet must cause plenty of mutations—and the favorable, survival mutation was now one that was deadly to man. I'll hazard a guess that the psi function even instigates mutations, some of the deadlier types are just too one-sided to have come about naturally in a brief three hundred years.

"The settlers, of course, fought back, and kept their status as a natural disaster intact. Through the centuries they improved their killing methods, not that it did the slightest good, as you know. You city people, their descendants, are heirs to this heritage of hatred. You fight and are slowly being defeated. How can you possibly win against the biologic reserves of a planet that can recreate itself each time to meet any new attack?"

Silence followed Jason's words. Kerk and Meta stood white-faced as the impact of the disclosure sunk in. Brucco mumbled and checked points off on his fingers, searching for weak spots in the chain of reason. The fourth city Pyrran, Skop, ignored all these foolish words that he couldn't understand—or want to understand—and would have killed Jason in an instant if there had been the slightest chance of success.

It was Rhes who broke the silence. His quick mind had taken in the factors and sorted them out. "There's one thing wrong," he said. "What about us? We live on the surface of Pyrrus without perimeters or guns. Why aren't we attacked as well? We're human, descended from the same people as the junkmen."

"You're not attacked," Jason told him "because you don't identify yourself as a natural disaster. Animals can live on the slopes of a dormant volcano, fighting and dying in natural competition. But they'll flee together when the volcano erupts. That eruption is what makes the mountain a natural disaster. In the case of human beings, it is their thoughts that identify them as life form or disaster. Mountain or volcano. In the city everyone radiates suspicion and death. They enjoy killing, thinking about killing, and planning for killing. This is natural selection, too, you realize. These are the survival traits that work

best in the city. Outside the city men think differently. If they are threatened individually, they fight, as will any other creature. Under more general survival threats they co-operate completely with the rules for universal survival that the city people break."

"How did it begin—this separation, I mean, between the two groups?" Rhes asked.

"We'll probably never know," Jason said. "I think your people must have originally been farmers, or psionic sensitives who were not with the others during some natural disaster. They would, of course, act correctly by Pyrran standards, and survive. This would cause a difference of opinion with the city people who saw killing as the answer. It's obvious, whatever the reason, that two separate communities were established early, and soon separated except for the limited amount of barter that benefited both."

"I still can't believe it," Kerk mumbled. "It makes a terrible kind of truth, every step of the way, but I still find it hard to accept. There *must* be another explanation."

Jason shook his head slowly. "None. This is the only one that works. We've eliminated the other ones, remember? I can't blame you for finding it hard to believe, since it is in direct oppositon to everything you've understood to be true in the past. It's like altering a natural law. As if I gave you proof that gravity didn't really exist, that it was a force altogether different from the immutable one we know, one you could get around when you understood how. You'd want more proof than words. Probably want to see someone walking on air."

"Which isn't such a bad idea at that," he added, turning to Naxa. "Do you hear any animals around the ship now? Not the ones you're used to, but the mutated, violent kind that live only to attack the city."

"Place 's crawling with 'em," Naxa said, "just lookin' for somethin' t'kill."

"Could you capture one?" Jason asked. "Without getting yourself killed, I mean."

Naxa snorted contempt as he turned to leave. "Beast's not born yet, that'll hurt me."

They stood quietly, each one wrapped tightly around by his own thoughts, while they waited for Naxa to return. Jason had nothing more to say. He would do one more thing to try and convince them of the facts, after that it would be up to each of them to reach a conclusion.

The talker returned quickly with a stingwing, tied by one leg to a length of leather. It flapped and shrieked as he carried it in.

"In the middle of the room, away from everybody," Jason told him. "Can you get that beast to sit on something and not flap around?"

"My hand good enough?" he asked, flipping the creature up so it clung to the back of his gauntlet. "That's how I caught it."

"Does anyone doubt that this is a real stingwing?" Jason asked. "I want

to make sure you all believe there is no trickery here."

"The thing is real," Brucco said. "I can smell the poison in the wing-claws from here." He pointed to the dark marks on the leather where the liquid had dripped. "If that eats through the gloves, he's a dead man."

"Then we agree it's real," Jason said. "Real and deadly, and the only test of the theory will be if you people from the city can approach it like Naxa here."

They drew back automatically when he said it. Because they knew that stingwing was synonymous with death. Past, present and future. You don't change a natural law. Meta spoke for all of them.

"We . . . can't. This man lives in the jungle, like an animal himself. Somehow he's learned to get near them. But you can't expect us to."

Jason spoke quickly, before the talker could react to the insult. "Of course I expect you to. That's the whole idea. If you don't hate the beast and expect it to attack you—why it won't. Think of it as a creature from a different planet, something harmless."

"I can't," she said. "It's a *stingwing!*"

As they talked Brucco stepped forward, his eyes fixed steadily on the creature perched on the glove. Jason signaled the bowmen to hold their fire. Brucco stopped at a safe distance and kept looking steadily at the stingwing. It rustled its leathery wings uneasily and hissed. A drop of poison formed at the tip of each great poison claw on its wings. The control room was filled with a deadly silence.

Slowly he raised his hand. Carefully putting it out, over the animal. The hand dropped a little, rubbed the stingwing's head once, then fell back to his side. The animal did nothing except stir slightly under the touch.

There was a concerted sigh, as those who had been unknowingly holding their breath, breathed again.

"How did you do it?" Meta asked in a hushed voice.

"Hm-m-m, what?" Brucco said, apparently snapping out of a daze. "Oh, touching the thing. Simple, really. I just pretended it was one of the training aids I use, a realistic and harmless duplicate. I kept my mind on that single thought and it worked." He looked down at his hand, then back to the stingwing. His voice quieter now, as if he spoke from a distance. "It's not a training aid you know. It's real. Deadly. The off-worlder is right. He's right about everything he said."

With Brucco's success as an example, Kerk came close to the animal. He walked stiffly, as if on the way to his execution, and runnels of sweat poured down his rigid face. But he believed and kept his thoughts directed away from the stingwing and he could touch it unharmed.

Meta tried but couldn't fight down the horror it raised when she came close. "I am trying," she said, "and I do believe you now—but I just can't do it."

Skop screamed when they all looked at him, shouted it was all a trick,

and had to be clubbed unconscious when he attacked the bowmen.

Understanding had come to Pyrrus.

XXVIII.

"What do we do now?" Meta asked. Her voice was troubled, questioning. She voiced the thoughts of all the Pyrrans in the room, and the thousands who watched in their screens.

"What will we do?" They turned to Jason, waiting for an answer. For the moment their differences were forgotten. The people from the city were staring expectantly at him, as were the crossbowmen with half-lowered weapons. This stranger had confused and changed the old world they had known, and presented them with a newer and stranger one, with alien problems.

"Hold on," he said, raising his hand. "I'm no doctor of social ills. I'm not going to try and cure this planet full of muscle-bound sharpshooters. I've just squeezed through up to now, and by the law of averages I should be ten times dead."

"Even if all you say is true, Jason," Meta said, "you are still the only person who can help us. What will the future be like?"

Suddenly weary, Jason slumped into the pilot's chair. He glanced around at the circle of people. They seemed sincere. None of them even appeared to have noticed that he no longer had his hand on the pump switch. For the moment at least, the war between city and farm was forgotten.

"I'll give you my conclusions," Jason said, twisting in the chair, trying to find a comfortable position for his aching bones. "I've been doing a lot of thinking the last day or two, searching for the answer. The very first thing I realized, was that the perfect and logical solution wouldn't do at all. I'm afraid the old ideal of the lion lying down with the lamb doesn't work out in practice. About all it does is make a fast lunch for the lion. Ideally, now that you all know the real causes of your trouble, you should tear down the perimeter and have the city and forest people mingle in brotherly love. Makes just as pretty a picture as the one of lion and lamb. And would undoubtedly have the same result. Someone would remember how really filthy the grubbers are, or how stupid junkmen can be, and there would be a fresh corpse cooling. The fight would spread and the victors would be eaten by the wildlife that swarmed over the undefended perimeter. No, the answer isn't that easy."

As the Pyrrans listened to him they realized where they were, and glanced around uneasily. The guards raised their crossbows again, and the prisoners stepped back to the wall and looked surly.

"See what I mean?" Jason asked. "Didn't take long did it?" They all looked a little sheepish at their unthinking reactions.

"If we're going to find a decent plan for the future, we'll have to take

inertia into consideration. Mental inertia for one. Just because you know a thing is true in theory, doesn't make it true in fact. The barbaric religions of primitive worlds hold not a germ of scientific fact, though they claim to explain all. Yet if one of these savages has all the logical ground for his beliefs taken away—he doesn't stop believing. He then calls his mistaken beliefs 'faith' because he knows they are right. And he knows they are right because he has faith. This is an unbreakable circle of false logic that can't be touched. In reality, it is plain mental inertia. A case of thinking 'what always was' will also 'always be.' And not wanting to blast the thinking patterns out of the old rut.

"Mental inertia alone is not going to cause trouble—there is cultural inertia, too. Some of you in this room believe my conclusions and would like to change. But will all your people change? The unthinking ones, the habit-ridden, reflex-formed people who *know* what is now, will always be. They'll act like a drag on whatever plans you make, whatever attempts you undertake to progress with the new knowledge you have."

"Then it's useless—there's no hope for our world?" Rhes asked.

"I didn't say that," Jason answered. "I merely mean that your troubles won't end by throwing some kind of mental switch. I see three courses open for the future, and the chances are that all three will be going on at the same time.

"First—and best—will be the rejoining of city and farm Pyrrans into the single human group they came from. Each is incomplete now, and has something the other one needs. In the city here you have science and contact with the rest of the galaxy. You also have a deadly war. Out there in the jungle, your first cousins live at peace with the world, but lack medicine and the other benefits of scientific knowledge, as well as any kind of cultural contact with the rest of mankind. You'll both have to join together and benefit from the exchange. At the same time you'll have to forget the superstitious hatred you have of each other. This will only be done outside of the city, away from the war. Every one of you who is capable should go out voluntarily, bringing some fraction of the knowledge that needs sharing. You won't be harmed if you go in good faith. And you will learn how to live *with* this planet, rather than against it. Eventually you'll have civilized communities that won't be either 'grubber' or 'junkman.' They'll be Pyrran."

"But what about our city here?" Kerk asked.

"It'll stay right here—and probably won't change in the slightest. In the beginning you'll need your perimeter and defenses to stay alive, while the people are leaving. And after that it will keep going because there are going to be any number of people here who you won't convince. They'll stay and fight and eventually die. Perhaps you will be able to do a better job in educating their children. What

the eventual end of the city will be, I have no idea."

They were silent as they thought about the future. On the floor Skop groaned but did not move. "Those are two ways," Meta said. "What is the third?"

"The third possibility is my own pet scheme," Jason smiled. "And I hope I can find enough people to go along with me. I'm going to take my money and spend it all on outfitting the best and most modern spacer, with every weapon and piece of scientific equipment I can get my hands on. Then I'm going to ask for Pyrran volunteers to go with me,"

"What in the world for?" Meta frowned.

"Not for charity, I expect to make my investment back, and more. You see, after these past few months, I can't possibly return to my old occupation. Not only do I have enough money now to make it a waste of time, but I think it would be an unending bore. One thing about Pyrrus —if you live—is that it spoils you for the quieter places. So I'd like to take this ship that I mentioned and go into the business of opening up new worlds. There are thousands of planets where men would like to settle, only getting a foothold on them is too rough or rugged for the usual settlers. Can you imagine a planet a Pyrran couldn't lick after the training you've had here? And enjoy doing it?

"There would be more than pleasure involved, though. In the city your lives have been geared for continual deadly warfare. Now you're faced with the choice of a fairly peaceful future, or staying in the city to fight an unnecessary and foolish war. I offer the third alternative of the occupation you know best, that would let you accomplish something constructive at the same time.

"Those are the choices. Whatever you decide is up to each of you personally."

Before anyone could answer, livid pain circled Jason's throat. Skop had regained consciousness and surged up from the floor. He pulled Jason from the chair with a single motion, holding him by the neck, throttling him.

"Kerk! Meta!" Skop shouted hoarsely. "Grab guns! Open the locks —our people'll be here, kill the grubbers and their lies!"

Jason tore at the fingers that were choking the life out of him, but it was like pulling at bent steel bars. He couldn't talk and the blood hammered in his ears.

Meta hurtled forward like an uncoiled spring and the crossbows twanged. One bolt caught her in the leg, the other transfixed her upper arm. But she had been shot as she jumped and her inertia carried her across the room, to her fellow Pyrran and the dying off-worlder.

She raised her good arm and chopped down with the edge of her hand.

It caught Skop a hard blow on the biceps and his arm jumped spasmodically, his hand leaping from Jason's throat.

"What are you doing?" he shouted

in strange terror to the wounded girl who fell against him. He pushed her away, still clutching Jason with his other hand. She didn't answer. Instead she chopped again, hard and true, the edge of her hand catching Skop across the windpipe, crushing it. He dropped Jason and fell to the floor, retching and gasping.

Jason watched the end through a haze, barely conscious.

Skop struggled to his feet, turned pain-filled eyes to his friends.

"You're wrong," Kerk said. "Don't do it."

The sound the wounded man made was more animal than human. When he dived towards the guns on the far side of the room the crossbows twanged like harps of death.

When Brucco went over to help Meta no one interfered. Jason gasped air back into his lungs, breathing in life. The watching glass eye of the viewer carried the scene to everyone in the city.

"Thanks Meta . . . for understanding . . . as well as helping." Jason had to force the words out.

"Skop was wrong and you were right Jason," she said. Her voice broke for a second as Brucco snapped off the feathered end of the steel bolt with his fingers, and pulled the shaft out of her arm. "I can't stay in the city, only people who feel as Skop did will be able to do that. And I'm afraid I can't go into the forest—you saw what luck I had with the stingwing. If it's all right I'd like to come with you. I'd like to very much."

It hurt when he talked so Jason could only smile, but she knew what he meant.

Kerk looked down in unhappiness at the body of the dead man. "He was wrong—but I know how he felt. I can't leave the city, not yet. Someone will have to keep things in hand while the changes are taking place. Your ship is a good idea Jason, you'll have no shortage of volunteers. Though I doubt if you'll get Brucco to go with you."

"Of course not," Brucco snapped, not looking up from the compression bandage he was tying. "There's enough to do right here on Pyrrus. The animal life, quite a study to be made, probably have every ecologist in the galaxy visiting here."

Kerk walked slowly to the screen overlooking the city. No one attempted to stop him. He looked out at the buildings, the smoke still curling up from the perimeter, and the limitless sweep of green jungle beyond.

"You've changed it all, Jason," he said. "We can't see it now, but Pyrrus will never be the way it was before you came. For better or worse."

"Better," Jason croaked, and rubbed his aching throat. "Now get together and end this war so people will really believe it."

Rhes turned and after an instant's hesitation, extended his hand to Kerk. The gray-haired Pyrran felt the same repugnance himself about touching a grubber.

They shook hands then because they were both strong men.

THE END

THE REFERENCE

LIBRARY

By P. SCHUYLER MILLER

THE "WISWELL" SYNDROME

OLDER readers may recall the hubbub that arose in 1940 when Kenneth Roberts' historical novel, "Oliver Wiswell," appeared. Much the same kind of furor may be afoot, in our own more restricted circle, over Robert A. Heinlein's "Starship Troopers" (G. P. Putnam's Sons, New York; 1959; 309 pp.; $3.95).

Roberts, after a series of unusually good, realistic historical novels on duly patriotic themes, stepped out of line in "Wiswell": he made his hero a Tory, and showed how the Ameri-

can Revolution must have looked to the people who remained loyal to England, and who suffered cruelly because they came out on the "wrong" side of a bitter civil war. He was a writer who set high standards for painstaking research and thorough-going integrity, and he made the mistake—if it was a mistake—of writing too well.

Northerners find it amusing today that the later civil war of only a century ago hasn't been forgotten in the South. Well, in much of New England and eastern New York, the fratricidal aspects of the Revolution haven't been forgotten either. "Tory" is almost as dirty a word in the Mohawk Valley as "Yankee" is in Mississippi. Roberts had already ruffled some feathers in the D.A.R. and various historical societies by making Benedict Arnold the hero of his two best novels, "Arundel" and "Rabble in Arms," but he had left the man without trying to explain —let alone explain away—the treason at West Point. After all, Arnold's valor *had* been recognized with a stele to his injured leg and a vacant niche in the Saratoga Battlefield monument.

Oliver Wiswell, on the other hand, was openly a Tory, and the villains of the book were the patriotic Americans who did him brutal wrongs with a sanctified grin on their jowls. The roof fell in! And so—judging from some of the "bheer party" discussions among writers and readers at the Detroit Convention—the roof may be about to fall on Heinlein.

What I've called the "Wiswell Syndrome" here is the nasty habit we have of assuming that as a good writer writes, so is he. This is an aspect of provincialism that refuses to remain provincial, a mark of naiveté that is apt to brand the most sophisticated. Fear of it is probably keeping many a writer from submitting a yarn to *Playboy,* lest it be accepted, printed, and hailed by his family and neighbors as evidence that he is a secret sex fiend and no longer fit to be an unpaid babysitter. It has probably kept some potentially good writers from submitting stories to this magazine, because the high school or college English teacher doesn't think science fiction is quite respectable. It assumes that Micky Spillane must himself be a sex-ridden sadist; it says that a man who writes understandingly and well about homosexuality is himself a homosexual.

In science fiction, we've not had much in the Wiswell line to bother us. Obviously, the man or woman who writes about BEMs is no bug-eyed monster himself. Pohl and Kornbluth weren't advocating the distorted society of their "Space Merchants" or "Gladiator-at-Law," or the even more horribly effete culture of their current novel, "Wolfbane." True, librarians, teachers, and the uninitiated public have sometimes been a little confused over the point where extrapolation and conjecture become advocacy and propa-

ganda—but not those of us who know what SF really *is*. We've pointed with pride to Robert Heinlein's ability to make the most improbable world wholly convincing and believable.

Now we're ready to condemn him as a militarist, a fascist, and whatever other words come to mind, because of "Starship Troopers."

The novel—which Putnam does *not* label a "juvenile"—is about twice as long as the serial which ran as "Starship Soldier" in *Fantasy & Science Fiction*. The cutting was done by a general thinning out that whittled meat off most of the book and lopped off a solid eighty pages and a whopping battle scene in which the real nature of the "Bugs" is finally discovered. In the process, it seems to me that something happened that makes the parallel with Kenneth Roberts even more apt. Roberts always insisted that the hero of his "Arundel" and "Rabble in Arms" was *not* Arnold, but the Northern Army. In the uncut book, the hero is not Juan Rico, but the Mobile Infantry of some seven hundred years in our future.

This is not a world I would like to live in. The Heinlein touches make that clear. Veterans are the only full citizens, with the right to vote, hold responsible office, and control their society. Flogging is an accepted punishment for what would seem to us quite minor infractions. Yet with this militarized, superficially austere culture we have an interstellar prosperity in which boys —and girls—fly their own helicopters at fourteen, and wear earrings —as did pirates and cavaliers alike, much less than seven hundred years ago.

(A word on that timing: seems to me the copywriter who did the jacket blurb has slipped up. Sargon of Akkad took over the ancient Near East some five thousand years before the time of the story, and his date was around 2300 B.C.)

The story line—and there is relatively little direct action, except at the beginning and end when the M.I. is fighting on one of the aliens' home planets—follows young Juan Rico through his Army career, from the time he makes his snap decision to volunteer until he has earned his lieutenancy in school and in combat. Rico tells his story rather than living it, and this in itself may have persuaded some readers that Heinlein is selling a bill of goods—that he is, in fact, trying to persuade young people that a military career is the only good life, the only real life, and the only life in which a man or woman fulfills his or her responsibilities towards society.

Whether Heinlein himself believes these things, only his close friends can say—perhaps only he can say. Those who claimed to know him best were divided, in the Detroit discussion. Some felt strongly that this is a bad book, a dangerous book, propagandizing for a point of view that we don't want identified with science fiction or with our society.

Obviously, they were also saying by inference that it is a well-written book, a persuasive book, an exciting book—in short, a Heinlein book.

Others, I'd say, felt that "Starship Troopers" is a kind of "Oliver Wiswell," a literary exercise if you will, in which the author is presenting a situation and a point of view with the same integrity that we would expect of him if his hero were a militant pacifist. Surely any writer has the right to choose an unpopular theme, and develop it with all his skill, without being condemned —without being identified with the thing he writes!

And I? It seems to me the key to "Starship Troopers" comes near the end, when Juan Rico and a couple of his fellow officer-candidates are on the carpet before Major Reid, one of their instructors. Out of this discussion, Juan develops an argument that goes something like this:

Both wars and moral rules derive from the instinct to survive, and to help one's family and one's kind to survive.

Can war be abolished by constructing a moral code under which population and resources are balanced? Maybe. But if we do, the "Bugs"—who have not eschewed war as an implement of survival—will move in and wipe us out, because we have what they need for *their* survival.

Does Man have the "right" to spread through the universe, and stamp out all competition?

Answer: "Man is what he is, a wild animal with the will to survive, and (so far) the ability, against all competition. Unless one accepts that, anything one says about morals, war, politics . . . is nonsense. Correct morals arise from knowing what Man *is*—not what do-gooders and well-meaning old Aunt Nellies would like him to be.

"The universe will let us know—later—whether or not Man has any 'right' to expand through it.

"In the meantime the M.I. will be in there, on the bounce and swinging, on the side of our own race."

Here we are in 1960, not 2660. We are up against World Communism, spreading out of Russia and China, instead of Pseudo-Arachnids from the planet Klendathu. Can we cut taxes? Can we reduce our military budget? Can we abandon our overseas bases, sink our Navy, disarm the hydrogen warheads of any ICBM's we may happen to have in working order? Can we turn our backs on war as an instrument of survival for our society, when the "Bugs" have not?

There's more to the book than just this argument for survival—*our* survival—come what may. The argument is no use unless you implement it, and Heinlein, in his Mobile Infantry, shows us the kind of tough, realistic Army that can do the job most efficiently, with the least waste of men, talent and resources. It's an Army that, from the moment a recruit signs his enlistment papers, never lets him harbor the idea that

war is a game. The Crusaders treated it as a game—and the Saracens won. The Cavaliers played at it—and the Roundheads whipped them. The Aztecs had the sport developed to a very high degree—and a handful of Spanish who fought realistically, for survival and loot, smashed a civilization.

If war is hell—and nothing in "Starship Tropers" says it is anything else—then the *only* sure road to salvation is to win as fast and as finally as possible. That's what the Bugs are trying to do. Can we do less?

THE DUPLICATED MAN, by James Blish and Robert Lowndes. Avalon Books, New York. 1959. 222 pp. $2.95.

Blish or no Blish—Lowndes or no Lowndes—this is not one of Avalon's best offerings. It suffers most from an over-van Vogtian complication of who is doing what for which faction, and its best feature is a fascinating and valid switch on duplication machines, which produce five quite different copies of plotter Paul Danton. However, the six Dantons get into the act too late to be used to their best advantage.

As for plot, we have two oligarchies—the Security Council on Earth and the Government in Exile on Venus—each with its own underground opposition: the elaborately entangled Pro-Earth Party here, the obscure Earth Party on the dusty, formaldehyde-soaked surface of Venus. Venus has been enclosed in the Thomas Screen, which lets chemical missiles through but explodes all nuclear weapons or engines; from behind this shield the Exiles, headed by a grotesquely fat, seemingly immortal Thomas, continually bombard the surface of the planet from which they fled and to which they want to return as rulers again.

Danton, a fairly important "dendrite" in the Pro-Earth Party, hopes to achieve peace with Venus by using the Duplication Machine to multiply the hierarchy of the Security Council, so that it will bog down in a muddle of conflicting actions by the replicas. Instead, he is himself replicated and some of him are sent to Venus to louse things up for the Exiles, one of whose leaders they resemble.

It all becomes very confusing before it's straightened out.

THE BEAST MASTER, by Andre Norton. Harcourt, Brace & Co., New York. 1959. 192 pp. $3.00.

Again Andre Norton proves that she can write just about the best far-worlds-adventure stories anyone is doing nowadays. They have color; they have action; they have mystery; they have the "sense of wonder" that some people would contend is out of place in Twentieth Century writing; and they are so well-written that every detail is convincing. I'm not sure that "The Beast Master" is one

of the best she has done, but its basic theme is a grand one—although it was used just as well in Murray Leinster's "Combat Team"—and I hope we haven't heard the last of Hosteen Storm and his team.

Storm is a Navajo Indian, one of the last survivors of a planet that was destroyed in a war with the humanoid Xiks. With the animals he has trained, and with whom he is in rapport, he joins the explorers and settlers of the colonial world, Arzor. Because, on Arzor, he expects to find the enemy he has never seen and whom he must kill for the honor of his tribe and his people.

Needless to say, much happens before young Storm, his eagle, his sand cat, and his two meerkats, come to grips with that hereditary foeman. He finds Arzor with its wild-horse herds much like the plains of lost Terra, and its goat-horned tribesmen good friends. He uncovers a triple mystery — of human outlaws who masquerade as natives, of a hidden outpost of the Xiks, and of an unknown, ancient race from beyond the stars, whose secrets are buried in the honeycomb of tunnels under Arzor's wild Peak country. And he finds his own Indian heritage both a handicap and an advantage in dealing with the native Norbies, whose ways are so like those of the ancient Navajos in the days before Man took to Space.

There are loose ends, but I have an idea the author has left them dangling for Hosteen Storm, and Logan Quade, and young Gorgol of the Norbies to knot up with the help of Baku the eagle, Surra the giant cat, and clownish, clever Hing the meerkat.

THE GOLDEN APE, by Adam Chase. Avalon Books, New York. 1959. 221 pp. $2.95.

This is one of the lows in the Avalon series, and I suspect the fault is largely the publisher's, even though the original magazine story, "Quest of the Golden Ape," can't have been any masterpiece. The *Amazing* — or was it *Fantastic?* — version can't have been much more than a novelette length, since Avalon has had to use oversize type, with widely spaced lines, to stretch it out to fill the standard number of pages. Then it must have run a few pages over, because there are places where chunks have evidently been lopped out of the narrative, without any attempt to smooth over the wound.

I am not one to complain when an old and honored plot or gimmick is well-handled, but I'll yawn and scream when it isn't. This is an Edgar Rice Burroughs formula with a few terms missing, a few signs wrong, and most of the constants treated as variables.

The John Carter of the book, who has Tarzan overtones since he's also a lost heir, is Bram Forest, who wakes from a hundred-year sleep in a vault on Earth, finds a mysterious disk—shades of Lens!—that snatches

him through space and time to the planet Tarth, plunges into a duel with the Bad Guy, is nursed back to health by the Heroine, is inexplicably yanked from Tarth to Earth when he's most needed, and so on. Skillful writers can make this kind of romp fun, and even convincing, but the interesting details are thrown away and the formula comes out with a negative value.

THE BODY'S GUEST, by Angus MacLeod. Roy Publishers, New York. 1959. 191 pp. $3.00.

Here is a light "sleeper" from a Scottish writer who leans toward Thorne Smith, but from natural reticence or lack of Smith's special talent for milking the possibilities of an outrageous situation, stays mildly mocking instead of becoming hilarious.

An Indian peddler with an education in nuclear physics, Ram Khatri, finds himself in the Highland village of Camaloch, in hot argument with the village schoolmaster over the merits and powers of Yoga. Khatri has built an apparatus which will duplicate some of the phenomena of yogism, and is needled into demonstrating it. The unplanned result is that nine men and a bull exchange personalities.

The switches are, to readers accustomed to the subtleties of the *Unknown* school of comic fantasy, pretty obvious. Khatri and the schoolmaster exchange; so do two politicians, each of whom then has to stump for his rival in the rival's body; so do the minister and the local drunkard; and so do the local innkeeper and his rather retiring competitor for a barmaid's favors. The bull switches with a nasty old goat of a man, and good riddance to them.

A fairly good scheme is arranged: carry on, keeping the bull-turned-man under cover, until Khatri/MacKenzie can fix his apparatus and switch them back again. But two of the women in the village find their men's actions peculiar, and call in the local doctor. The rest is a chase yarn. It's fun, but a lot of possibilities are overlooked or let go to waste.

THE PEOPLE MAKER, by Damon Knight. Zenith Books, Rockville Centre, N. Y. No. ZB-14. 159 pp. 35¢

There is nothing in the rule book that says a critic who holds that all stories should be literary gems has to write all literary gems himself. By the same token, when a writer tries to tell you two stories where one would be enough, he's setting up extra hurdles for himself. That is what has happened with this story about a matter-duplicator that wrecks the world.

The first thirty-four pages were a novelette published in 1957 in *Fantasy & Science Fiction* as "A for Anything." They have been condensed here to make them no more

than the prelude to the main story, which really doesn't add up to much more than a documentation for the cover blurb, "lust and decadence ruled a world gone mad."

In Part I, laid in our immediate future, the nominal hero invents a "Gismo" that will duplicate any object attached to it. Dave Ewing thinks his invention will liberate mankind from all need, wars, and other sources of social friction; his father and a friend try to convince him that societies aren't made that simply, and that all hell will break loose if he makes the secret of the Gismo public. But he does, and it does—since no material object is worth anything, personal services are the only thing of value. The episode ends as Dave and his family are ruthlessly inducted into slavery.

Part II takes us into the slave society, seventy-eight years later, in 2039. The new hero is young Dick Jones, only sixteen and future master of Buckhill, the most important feudal estate in the mid-Atlantic region. Dick is to go to Eagles, in Colorado, to train for manhood under one of the politically and socially prominent lords of the time. But he is drawn into a duel, flees to Eagles as a fugitive, and promptly gets himself in wrong with the very people whose favor he should be seeking. This familiar gambit, developed with much enticing detail, culminates when young Jones allows himself to be drawn into a revolutionary plot, is double-crossed, lands in the midst of a slave revolt, and—unknown to any but the reader—sees the whole cycle start again.

There are technical flaws in the original gimmick that the author either didn't see or didn't bother to explain away, although he could have done so. A mirror-image bolt would be threaded the wrong way, and wouldn't fit an ordinary nut, for one trivial thing. And mirror-image food might not be digestible—at least, nature seems to make all its molecules of one species, for unknown reasons. It's hard, too, to believe that so great a change in the social order could have taken place in seventy-eight years, and that the past before the Gismo could be so completely forgotten. Worst of all, you never quite get the "feel" of the tangled social order of the Eagles—and that is the real reason for a book like this, if it's to be considered more than entertainment. Fritz Leiber hasn't yet been surpassed when it comes to showing a thoroughly rotten society in a very few words.

STAR SCIENCE FICTION NO. 5, edited by Frederik Pohl. Ballantine Books, N. Y. No. 308K. 159 pp. 35¢

The anthology of all-new science-fiction short stories was invented by Ray Healy, with his "New Tales of Space and Time." Ballantine took up the idea in three simultaneous hard-bound and paperback collections—switched to magazine form—and has now switched back to paper covers.

This second of the new run has nine new yarns by some well-known writers and some new ones. Look on it as a super-issue of your favorite SF magazine, and shell out your 2.8 bits.

It's hard to make a choice, but I think my favorite for the book is Chan Davis' "Adrift on the Policy Level," which satirizes the heirarchy of Big Business deftly and keenly. The author—as Dr. H. Chandler Davis—is a mathematician at the Institute for Advanced Studies, Princeton. Davis' chemist hero forges ahead very encouragingly, whereas Daniel F. Galouye's delegation from Earth get a handsome governmental runaround in "Diplomatic Coop," but the two stories are kin all the same. And "Hair-Raising Adventure," by Rosel George Brown, a new writer, also gives Private Enterprise a drubbing — a rollicking drubbing, one could say—as a seemingly innocent paleolinguist is beset by connivers who want the Scythian recipe for hair tonic that he has discovered.

Another excellent comedy — the whole book's unifying note is humorous—is the opening story by Katherine MacLean, whom we all know, and Tom Condit, who—we don't. The title, "Trouble With Treaties." The plot: a warship of nastily predatory aliens are outsmarted by the poker-playing crew of a human ship, nicely aided by a sleek black cat. It's the kind of story that once grew primarily in these pages. So is "Company Store," in which a colonist on a far planet finds himself stretched uncomfortably taut between his contract to the Company that sent him to Quellac and an alien merchandising robot that has set up shop there and makes with both the hard and the soft sell. It's one of Bob Silverberg's nicest.

The remaining stories are almost "straight" but far from ordinary. Richard Matheson's burlesque "A Touch of Grapefruit" envisions Los Angeles as a living, growing fungus disease, ultimately infecting the entire planet. "The Scene Shifter," by British author Arthur Sellings, shows us what happens when old moving pictures develop unexpected, mocking changes. "Star Descending," by Algis Budrys, introduces the concept of an instant-counseling service, ready to put just the right words in your mouth on every occasion—then brings it smash! up against a competitor even tougher than itself. Finally, Gavin Hyde's strange little "Sparkie's Fall" shows us a small man goaded to a drastic deed by well-meaning aliens.

THE STARS ARE TOO HIGH, by Agnew H. Bahnson, Jr. Random House, New York. 1959. 250 pp. $3.95.

If hardcover science fiction goes down and out in the United States, as some prognosticators believe may happen, one reason will be that mainline writers have rediscovered it as a potent medium of expressing ideas, and mainline publishers have

taken it back into the fold of "serious" fiction, where the best of it has always belonged.

The author of this book is an industrialist, composer, and part-time painter who is sponsoring gravitational research at the University of North Carolina. Whether he knows anything about science fiction, his brief biography on the jacket of his novel does not say. Certainly the publisher has no intention of letting the term slip out.

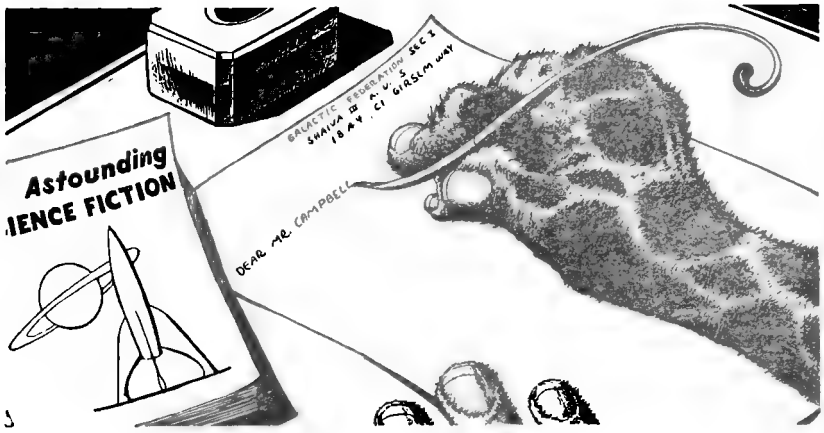
It's a good, if rather familiar story, which would have been better if the author had had more experience as a fiction writer, and more knowledge of the pitfalls of this field. It may make better reading for nonfans than for initiates.

As the book opens, Dr. Henry Alvin, scientific adviser to the United States Air Force, is called to the Pentagon for a conference at which he sees top-secret radar films of a UFO behaving as no known aircraft could behave. And he was on the craft when it was detected—one of a conspiracy for peace. The craft, the *Argonaut,* has a controlled-gravity drive that gives it range and mobility beyond anything else on Earth. Its inventor and backers intend to give the United States and Russia an ultimatum: they will pretend to be Powers from the Stars, who can destroy Earth unless it disarms and abandons war. They hope the *Argonaut*'s antics will be the persuader.

But the personalities of the conspirators begin to get in the way of this scheme. Alvin, naturally, is torn between his responsibility to the Air Force and his desire to see the plan succeed. Max Schoeller is a German scientist who stumbled on the gravity-control field just before the fall of Nazi Germany. John Sloan is an industrialist and idealist whose money has made the further working out of the ship possible. Jack Baker, an old friend of Alvin's, is a young pilot who found Schoeller and brought him to Sloan, and who has suddenly fallen in love with a young woman pilot in Cleveland. The fanatic—the idealist—the adventurer—the scientist trapped in the middle: four well-meaning amateurs blunder into a situation which may set off the war they are trying to prevent. For neither the United States nor Russia can or will believe the corny "friends from another star" messages dropped by the *Argonaut;* each believes the starship's pamphlet raid has been a power-demonstration devised to terrorize the opposition, and each is ready to shoot first and damn the consequences.

The working out of this situation is Bahnson's story—pure science fiction all the way, even to his final gimmick, but a relaxed kind of SF in which people sit around and talk about the things they are doing, instead of just ramming out there and getting them done. That, I guess, makes it a serious novel.

THE END



BRASS TACKS

Dear Mr. Campbell:

"... We have achieved a high-level industrial culture, with all that implies in terms of social, economic, and biological-health benefits. But—*we don't know how we did it!*"

JWC, Astounding Science Fiction, November, 1959.

That is true only if "we" is taken to mean "most Americans." With all modesty, the few of us with even a rudimentary grasp of economics and political history know how we did it. First, we evolved a libertarian political system wherein the powers of government were constitutionally limited to a minimum, freeing the creative energies of the populace. Second, and what is essentially a consequence of the first point, we adopted the principles of the free market economy, thus allowing those creative energies to be utilized with comparatively high efficiency. (I shall not try to defend these points since that would take, and has taken, volumes.)

As with most great changes in human life, ideas are at the root. The American success arises from three ideas: (1) The purpose of life is to develop the character—the soul, if

you prefer—of the individual, and personal liberty is the *sine qua non* of moral growth. (2) The only proper function of government is to protect the citizen from the depredations of other men. (3) Free men, working each for himself, can benefit themselves and society as a whole far more than can any system of government direction.

America never behaved in perfect accord with these principles, but we came closer than any other nation, and our material success was the direct consequence. But these ideas have been steadily replaced by notions hostile to the ideals of limited government and the free market, until now we are running mostly on the momentum of our accumulated successes. We no longer understand how we did it, not because there was anything mysterious or accidental about the process, but because we—most of us—have rejected the system of ideas and principles which make the process comprehensible. Having re-adopted the reactionary ideas of Eighteenth Centural Mercantilism—we call it the welfare state—we are, of course, unable to defend the liberty in which we no longer believe.

Because we have abandoned our libertarian ideals, all we have left to offer other peoples are the material products of our civilization. The Communists offer an idealistic religion* which satisifies the psyche, as well as the promise of material plenty to come. And men are so constituted that the appeal to ideals is immeasurably more inspiring than mere physical welfare.

The West will never be able to defeat the Communists until we regain a solid and communicable belief in the spiritual value and moral superiority of Western Civilization. This is impossible until we first recognize our great mistake: We have already adopted the shoddy Marxist philosophy that material development and a rising standard of living are the primary purpose of human life.

The measure of our philosophical surrender is our persistent belief that Communism grows on poverty, despite the overwhelming evidence that it is an *intellectual* disease that first attacks the middle and upper classses. The West is doomed so long as it believes that Communism can be turned back by raising the living standards of the "underdeveloped" nations.

We will win only if we reject the philosophy of materialism and re-accept, and preach, the moral values of liberty. In this, we have the inherent advantage that individual liberty is also the surest way to material welfare, but that should be treated as an unsought and largely irrelevant benefit, rather than as the basic argument.

---

*Even though they employ such pseudo-atheistic phrases as "dialectical materialism" and "historical necessity," the tenets of Communism amount to a faith in a supernaturally imposed teleological order in the affairs of mankind. This is religion.

"Communism is—whether we like to realize it or not—the best *known*

method of going from feudalism to industrialism."

JWC, Astounding Science Fiction
November, 1959

Indeed? The Japanese did it in fifty years, from about 1870 to 1920, without benefit of Communism. While Japan was far from democratic, she was immensely more liberal than any Communist state. At the least, Japan became industrialized without having to murder ten per cent of the population.

You seem to implicitly assume that a developing economy must recapitulate all the stages through which the advanced nations passed. But obviously, the forty years of Communist development cannot be compared to the one hundred-seventy years of American growth, because we had to invent everything cold, while they could take full advantage of our experience. Children do not have to learn everything by personal experience; they receive in school the accumulated knowledge of the race. Before we applaud the Soviet achievement, we must ask, how far would they have gotten *without* Communism? Considering the appreciable growth of Russian industry before the Revolution, is there any reason to suppose that the welfare of the Russian people would not have improved at least as much under a liberal regime—such as that of Kerensky—as it actually has under the Communists? Bearing in mind, of course, that while a liberal Russia might not have achieved so much industrialization, the people would be better off because a far smaller proportion would go to armaments.

The basic problem of the so-called "underdeveloped" nations is that their cultural patterns are unsuited to industrialization — obviously, else it would already have taken place—and the people are unwilling to change. The Communist solution is to impose the cultural changes by force, with whatever bloodshed is required. The free market economy works far better than Communism, but it must by definition be accepted by free choice. The aim of the West should be first to prevent Communist military conquest, so that the underdeveloped nations can make a free choice, and second, to persuade them to choose liberty and the free market. As I said above, the best way is to offer the inspiring ideals of liberty, rather than a purely materialistic and economic argument.

In passing, the Communist method of industrialization is "do it yourself," i. e., the underdeveloped nation must tighten its belt and wring development capital out of its already poor economy. The West can offer immense private capital assistance, but first we must persuade the needy nations that private foreign investment is not "exploitation," but is beneficial to everyone. Again, this is a matter of philosophy and ideology, since the hostility to foreign investment springs largely from acceptance of Marxist beliefs.

But—obviously—we are helpless

until we ourselves understand and believe in the principles of liberty. In short, the West faces one hell of a job of education, and must begin with self-education. — George W. Price, 2340 Lincoln Avenue, Chicago 14, Illinois.

The essence of achieving industrialization is to work and produce capital goods, instead of consumer goods—to produce tools instead of products—until you have an industry.

This requires that the population be compelled to save, rather than consume. But people in backward nations characteristically resist efforts to induce them to save.

Japan industrialized rapidly—by imperial edict of the absolute ruler. The Imperial Government was able to compel the saving—the self - deprivation—absolutely necessary to accumulation of capital—tools.

In the United States this was done for us by the much despised "robber barons"—the men like Carnegie, Gould, Vanderbilt, Rockefeller and the like who built the great tools of industrialization—railroads, steel mills and oil refineries.

Today, of course, we strongly reject the idea of someone compelling the people to do what they do not want to do.

Dear Mr. Campbell:

If your editorial in the November number is correctly reasoned, we can't possibly win, or even pull a draw; the only logical course is to let Russia have the backward areas uncontested, which means in the end virtual control over our present friends as well; and then make the best deal we can to live from then on on Russian terms.

As this is a middling issue of importance, I hope you don't mind my pointing out a leaky chink or two.

First, however, I agree with you that it is nonsense to expect the retarded areas to take up on our style democracy, or any style democracy. It took the Anglo-Saxon peoples about nine hundred years to arrive at it via constant civil war of both cold and hot varieties, the latest major episode of which ended in 1865. Many of these present people are even farther back from scratch than the Saxons and Normans in 1066. The current peoples of Africa and Latin America who are trying it certainly have shown few signs of being able to make it in fifty years.

On the other hand you are integrating Soviet politics with Soviet industrialism in order to make your point, and the resultant calculation is off on the following points:

1. One hundred fifty years for us as against forty for Russia is incorrect. I have been around nearly seventy years and can testify from experience and observation, backed by tangible history, that at least seventy-five per cent of our progress in consumer's goods took place in the last fifty years. Before that we were much

in the condition that the Russians are trying to get out of—concentrating on heavy plant buildup. No matter what social system you use, you have to have a plant to produce goods before you can produce them.

2. Before World War I Russia herself was beginning to move into higher gears and come out of the Dark Ages industrially as well as politically. The war plus the revolution threw that back to the point the Soviets started from, but it is faster retracing ground than breaking it new; even though the revolution virtually destroyed the technology by exiling or shooting most of the trained technologists, who had "bourgeois" backgrounds.

3. Even so, they did not start from scratch: they started from *us*, and other more advanced nations. They didn't invent their own industrial processes; we had had to work ours out the hard way over generations, and they took them over.

4. Moreover, they got them more directly than by book study; after the revolution they hired thousands of foreign technologists, mostly Americans, to put them on their feet again. I knew quite a number of these men and got some firsthand dope from them. Granted that they are now doing the same thing for backward areas, let's anyway put the credit where it belongs.

5. We are *also* doing that for backward areas, now. American technologists and engineers are fanned out all over the place teaching American technology and setting up plants and operations in undeveloped areas. Not only that, but making plenty of friends doing it. This has been a really remarkable program of achievement that somehow has been generally overlooked in the press—but then we engineers, et cetera, are used to being overlooked in the press, while the politicians and promoters grab the credit. I have had some inside looks at this through U. N. correspondence—was designated as suitable for a U. N. job in the Middle East, but lost out on physical examination, which is tough to pass at my age. In addition, you might take a look at the "Engineers Wanted" columns in the technical journals for the past few years.

6. This work bypasses the political angle entirely. We are working with the regimes as they are. (And for anything as backward in some cases you would have to go back quite a few centuries in the Occident.) There is no logical reason whatever why the Soviet system of control should be the one best fitted to handle technology. *Any* autocratic regime with the necessary motivation can do it; even any unautocratic regime that is progressive enough to let the technical-minded element be educated and give it its head can do it. As a matter of fact these areas can industrialize faster if they do it straight than they can by complicating it either with communism or democracy. However, our technological presence indirectly has the result of selling the people on the United States simply by observation of how we go

about it, to the extent at least of wanting to know more about how we do things in general; and it has the tendency to liberalize, if not democratize, the governments. A benevolent and enlightened autocracy of any kind can change a system for the better faster than any other kind of regime; the only drawback is lack of liberty, which those people never had anyway. Some of these regimes are not fools; they know the handwriting on the wall when they see it. They are no more anxious to see their power lost — and their heads with it — to Russia, than we are anxious to see Russia take over, and they know that that is what is going to happen if they try to continue Twelfth Century governments. In the matter of fast industrial changes, actually the worst thing we could do would probably be to tie technology up with attempted democracy at the same time. Russia seems to be getting the idea that it isn't advisable in all cases to tie it up with outright Communism either. You go a long ways backward in a revolution before you get going again, especially where you have fixed mores and religious ideas of a few thousand years' standing to combat.

7. The Russian progress is not merely due to Russian ability plus the Russian high pressure system plus the jumpoff from previously existing technology. It is also due to enormous natural resources. The other areas in very few cases have the Occidental technical aptitudes —which the Russians have in spite of a Tartar strain, and in even fewer cases the natural resources. There is also that question of established habit. Russia as an independent integrated country is not much older than colonial United States; dating back to the Sixteenth Century or so.

8. The histories of nations run definitely in cycles. Russia is pretty close to the same point of her development as we are, and it is a fast-rising point. Many of the areas under contest had their peak and passed it many centuries ago.

9. Hence, when put to the pragmatic test there are likely to be more Communist flops than successes in these areas. If we ride it out far enough the demonstration in practical terms will many times be in *our* favor. The recent Communist flop in India is an example in point of what is likely to happen, and something like it can happen in China in the long run. Progress there, and the popularity of the Communist regime, have been much exaggerated. The technical naivete of any outfit that thinks it can make industrial steel in backyards has a long way to go yet.

10. Conclusion: all isn't lost yet. I am still going to be able to sleep nights in spite of your editorial.

However, there is a very good chance that we are going to lose out from another angle entirely. It is not necessarily critical that we can't export democracy. It *is* critical what else we can export. This consumer hooraw means the using up of natural resources—all of them but lumber—at a geometrically increasing rate; and

at least half of it is waste according to any sane standard of the needs of living. Russia is still far behind us in consumption of natural resources, which in many cases were far superior to ours to begin with. (Oil, for instance.) Under the Soviet system—and this is one of its advantages—there is no tendency toward artificial stimulation of consumers' desires and hence practically no possibility of the extravagant waste of our own present system. Also, no matter what its efficiency as compared with backward areas, it is inherently far more slow-moving in development. Hence, the downhill side of Russian resources will be reached a long, long time after we are in our own critical bind. And we can't maintain our place in the world without trade, and any time we lose the trade we will have to live on Russian terms. We will then be the ones begging Russia for trade—at her own prices. But that situation is being accelerated by two factors; increasing competition by Russia at prices we can't meet, which in turn is being accelerated by the inflation that has already priced us out of several European markets. All the Russians have to do is wait a generation or two and we will fall into the bag fully ripe —all of our own doing.

We obviously aren't going to pass sumptuary laws to cut down consumer usage and we obviously aren't going to stop periodic wage raises. We are going to wait until we become a Russian satellite and let *them* do it for us. Our only other out would be to do what other have-not nations have done — make war to grab the resources of other people, same as Germany and Japan did. And where would that get us, since by that time we would have no friends and the A-bomb will still be there—or be easily revived if previously banished?—Victor Endersby, Napa, California.

My editorial dealt with "the war for men's minds"—which is not the same thing as a struggle for objective facts. The salesman, like the general, when engaged in war doesn't seek to be fair, but to be effective. So a major part of the problem is to realize that Russia has some extremely attractive talking points.

And Russia did "do it in forty years"; the same Western technology was available to all the backward nations in 1919; Russia alone did something about that fact. China, for example, did not —until Russian example led them to their own Communist Revolution.

Democracy, dislike the fact as we may, is not competent to produce really rapid development in an already established culture. Human beings do not like to change; children don't vote themselves into school. What Union ever voted for harder work at lower pay? To make the transition from feudalism to industrialism there must be a period of harder work at lower pay—because in-

dustrialism requires accumulation of capital goods. During the accumulation period, the working people of the culture must produce enough to live on plus the capital goods. They must work harder than they did to subsist; their reward per man-hour must be lower, because the capital must be accumulated.

It takes an autocratic system to make uneducated, unenlightened men accept such conditions—or accept the education and enlightenment they need to become an educated and enlightened people!

Please note as a simple fact: In New York City a parking-meter collection supervisor is paid, by the City, a higher annual wage than a high school teacher. If the people of New York are unwilling to pay for education—would U Chong be willing not only to pay for it, but submit to its discipline after he'd paid for it?

People go to the dentist, and pay him to do a painful operation, only because they are cruelly driven by the autocratic nerve in the aching tooth—not because they know it is good and wise!

Dear Mr. Campbell:

Re your editorial "Ultrafeeble Interactions" and the antigravity gadget you mention, did you ever hear about the so-called "Mystery Spot" a few miles from Santa Cruz, California?

If you did not, please look into that matter. I went there myself last Sunday: It is an area of exactly one hundred fifty feet, exactly circular. Towards the center, about ten feet away, gravity laws are certainly changed. And it's not an optic illusion. You can throw a billiard ball down, and it falls at an angle. People likewise stand at an angle.

This is not a psychological phenomenon. It is not suggestion. My own explanation is that a very heavy object is buried in the center, probably meteoric in origin. (Talking to the attendant I heard that they drilled a one hundred foot hole in the mountain and found earth scorched.)

As far as I know no physicists ever did come up with an explanation. The logical step would be to determine the exact center and dig out the gravity-changing object. But that idea is obviously too simple to grasp for the various learned men who are supposed to have studied the area.

Any suggestions?—Werner Bergmann, M.D., 1904 Franklin Street, Oakland 12, California.

I've heard about it—and others!—but never had a chance to investigate.

THE END

(*Continued from page* 7)

toward a nameable goal, but simple inquiry into "What exists in the Universe?"

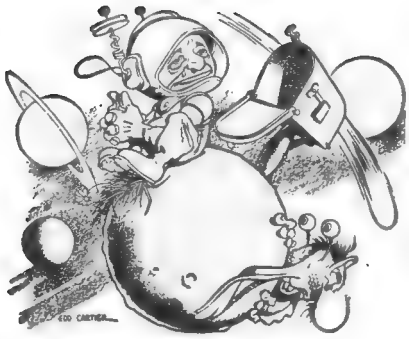
I believe all of the readers of this magazine will agree freely that this proposition is valid. Fundamental research is extremely important and is, at this era of history, being slighted in favor of developmental research.

Let me get it clear before going further: I hold that the proposition the Report seeks to establish is entirely valid. The Navy—and a good many other research centers!—should invest double, or more, the present amount of time-effort going into basic research.

This I believe is a Truth—and that the Navy research department is acutely aware that that Truth is not self-evident is evinced by the great amount of time-effort-money they expended in this Report intended to communicate it.

I'm predicting not on a what-I-think-should-be basis, but on a what-I-think-will-be basis when I say I fear it isn't going to produce much useful effect. The essential trouble with it is that it was, of course, prepared by scientists, with the full orientation of scientists, and is directed to nonscientist administrators with the full orientation of nonscientists.

One of the nastiest parts of a nonscientist's orientation these days is one the scientists have taken care to plant on him; "You are, of course, a layman, and can't understand



MOVING?

Going to have a new address?

We can't send your regular Astounding Science Fact & Fiction along if you don't warn us ahead of time. If you're going to move, let us know six weeks in advance. Otherwise you'll have a neglected mailbox!

Write SUBSCRIPTION DEPT.
Astounding
Science Fact & Fiction
304 East 45th Street
New York 17, New York

these matters. They are much too complex to be explained in lay terms."

That is a very fine communication bloc indeed. The trouble is, it's like cutting a telephone line so people will stop annoying you by calling. It works two ways; you can't call out when you need to, either.

That "you're just a layman" bit is, in fact, a demand that the layman accept the word of the scientist as an Act of Faith—because, the scientist says, explanation to his lay mind is impossible. "Trust and obey me," says the scientist, "because there's no other way. It can't be explained to you."

Now that little Act-of-Faith business is a Truth that the Scientists aren't at all willing to accept as either valid or self-evident. That doesn't keep it from being real. Verbally, the scientist denies that acting on faith is sound—yet in fact, he demands it.

Look: If you cannot explain to John Jones why he should do as you insist, and yet demand that he do so, on what basis are you telling him to act? Reason and enlightenment? Facts and figures? Logical prediction? No; if you cannot explain—which means communicate understandably—the reasons for acting as you insist he should, *you* may be acting on facts, figures, reason, enlightenment and logical prediction . . . *but he isn't.* He must, if he acts, be acting on the basis of trusting you blindly, for he cannot see.

It's a simple necessity; if the scientist cannot explain to the layman, cannot communicate the meanings of his works, then it follows that the layman is being asked to trust and obey the scientist blindly. The scientist who says "I cannot explain, but you must do as I say," is demanding an act of faith of the layman.

And there's nothing wrong with that—science to the contrary not withstanding! It's actually necessary in any human system—provided only that the two parties involved both have the grace to acknowledge that that is precisely what they are demanding.

In the case of this Report, there is, as usual, a crucial point which is that worst kind of a lie—the lie that is the truth and nothing but the truth. That's the kind of lie that a man can believe in sincerely, with massive evidence to back up his conviction. A statement that is the truth, and nothing but the truth, can be demonstrated massively, and can never be proven wrong in any respect. Its flaw is simply that it's not the whole truth.

But if another man has experienced the additional truth, and you, in all honesty and sincerity tell him that *only* your truth exists, he knows you're not to be trusted fully. Either you are unaware of an alternative truth, and thus suffer from blinding ignorance, or you are concealing an alternative truth deliberately. A man who is blind on one side is not a safe guide through dangerous coun-

try; one who deliberately conceals truth is not to be trusted either.

The fundamental attitude underlying the concept of Basic Research as set forth in this Report is one that is generally accepted among professional scientists—that every invention derives from a preceding fundamental discovery, and that these fundamental discoveries are absolutely necessary to technical progress.

The Report states (Vol.1. P. 64):

"In every invention there exists a key fact, the last to be discovered of all the facts, relationships and principles which were necessary before the invention could be made. Some inventions have been made very quickly after the discovery of the key fact, others have been made long after, but no invention was ever made before the discovery of its key fact."

I've done some checking—you can try it yourself readily enough. That statement there, the fundamental thesis of the Report's analysis of the need for basic research, is false-in-fact—and most intelligent nonscientists spot the flaw within a few minutes. Lawyers, in particular, spot the falsity rapidly; they've been trained in evaluation of and analysis of evidence.

Most national administrators can safely be classed as "intelligent nonscientists"; a large percentage of them are lawyers, and all of them have legal assistance immediately at hand.

The Report makes the serious mis-

Graduate Now Full-Time Writer

"Just made my 500th sale!", writes Kelvin Coventry of Derby, N.Y. "I'm hitting plenty of national magazines and have been full-time free lancing four years now—all of which was only a dream when I was plugging along in a dead-end factory job."

Wanted: More New Writers

of Short Stories, Articles, Mysteries, Science Fiction

Would you be willing to spend a few hours a week learning to write to earn $500 to $1500 a year in spare time? Or many thousands full time? Opportunities for new writers are greater than ever, and you don't need to be a "genius" or have a big name in order to succeed.

Earn While Learning

Now it's easier than you may imagine to learn to write, through Palmer's unique home-study training — for *not* just one field, but for *all* — Article, Fiction, Radio and TV. Many students earn while learning. Gerry Erwin won a story contest while on Lesson Nine of the fiction course. Lucille Anderson has sold a series for $1800. Palmer Institute is an accredited school, endorsed by famous authors and hundreds of successful graduates.

FREE Offer Shows How

Learn about *your* opportunities as a writer. Send today for free typical lesson package and 40-page book, "The Art of Writing Salable Stories." No obligation, no salesman will call. Write: Palmer Institute of Authorship, Desk ASF-30, 1680 N. Sycamore, Hollywood 28, California.

Mail Coupon or Send Postcard

FREE

Palmer Institute of Authorship
Since 1917
1680 N. Sycamore, Desk ASF-30
Hollywood 28, California

Please mail me typical lesson package and free 40-page book, "The Art of Writing Salable Stories," showing how you help new writers get started and experienced writers increase their income.

Mr.
Miss
Mrs. _____

Address _____

City _____ Zone____ State_____

Please print clearly. Veterans: Check here ☐

take of presenting a one-sided truth as the whole truth—and to precisely the group who have just the orientation necessary to be acutely aware of the flaw—but *not* strongly aware of the truth.

The false-to-fact statement is ". . . No invention was ever made before the discovery of its key fact." On the truth or falsity of that statement rests the entire case for the *absolute necessity* of fundamental research.

The statement is, quite plainly, false. "Key fact," as used in the above statement, is sharply distinguished from "invention"; "inventions" result, says the statement, from the assemblage and interaction of "key facts."

The Roman engineers used mortar; it was excellent mortar, and its action depends on certain key facts concerning the physical chemistry of calcium oxide, calcium hydroxide, and calcium carbonate. Without these key facts, the action of mortar cannot be understood, nor could it be predicted. Without those key facts, the possibility of mortar could not be deduced.

But it could be, and was, simply and directly invented. Entirely without benefit of any key facts whatsoever.

The only absolute statement you can make about an invention is that "no invention was ever made before it was invented." The fact is that an invention *needs* no external-to-itself concepts, ideas, or facts. An invention can be, and most of those we use today actually have been, made by pure random trial-and-error. No key facts whatever were known before the invention.

One of the most important inventions ever made was the invention of using the stored bond-energy of a tri-phosphate to carry out biochemical reactions. The organism that originated that had no key facts to deduce from and was incapable of

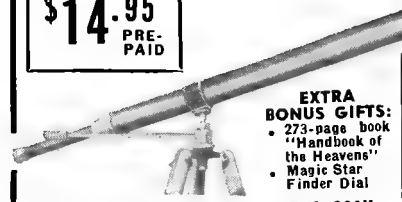
NEVER AT THIS LOW PRICE!

Genuine 120-POWER

ACHROMATIC TELESCOPE

with Achromatic Coated Lens

ONLY $14.95 PRE-PAID



EXTRA BONUS GIFTS:
- 273-page book "Handbook of the Heavens"
- Magic Star Finder Dial

4 Magnifications 20X, 40X, 75X, 120X
Brings the Moon, Planets, Stars, Satellites, People 120 Times Closer, Clearer, Sharper

Never before has a genuine ACHROMATIC 120X telescope with tripod sold for anywhere near this amazing low price! Now, explore the heavens and bring the moon, planets, stars, satellites 120 times closer, observe all distant objects, people, ships, etc., because all pictures are erect and so crystal clear you feel like reaching out and touching them. The kind of needle-sharp color-free viewing that is only possible with this genuine high speed achromatic precision lens. Ready for immediate use. 5 precision lenses bring you viewing at 20X, 40X, 75X, 120X. Tubes extend to 43", made of bakelite finished in camera bellows black, trimmed with gleaming brass. For extra stability, exclusive 5 ft. hardwood folding tripod is equipped with heavy cast iron head fitted with 360-degree all-aluminum mount that locks instantly in any position with single remote control lever. 2 famous gifts—273-page book "Handbook of the Heavens," and Magic Star Finder Dial that aids in locating stars, ANYWHERE at ANYTIME of the year. You must be completely satisfied with this outstanding, exclusive offer or your money back in full. Shipped Complete, nothing else to buy at the amazing low price of $14.95.

Send Cash, Check or Money Order Today

Dept. ASA-2, OPTIK INSTRUMENT CO.
509 Fifth Ave., New York 17, N. Y.

deducing if it had had the key facts.

Since the Report's statement clearly distinguishes between "key facts" and "inventions," it is evident that the writers do not consider an "invention" to be a "key fact."

The difficulty is that in trying to communicate a valid truth—that basic research is highly desirable and useful—they have made the mistake of claiming that it is not merely desirable and useful, which is true, but that it is absolutely necessary to invention—which is false!

That is, flatly, absurd. But it's something that a professional scientific orientation makes easy to accept —because one of its implications is that, if it be true, then the layman cannot make inventions, because he lacks the key facts absolutely necessary to invention.

What is badly needed is a Report that makes a real study of *both* avenues to invention—and acknowledges, even if it can't explain or understand, the fact-of-experience that intuitive inventors do arise, and do come up with inventions without any known key-facts behind them. We need to be able to evaluate how such intuitive inventors can be encouraged, how much time-effort-energy should be invested in encouraging Basic Research's greatest competitor—the Intuitive Inventor who gets answers without reasons.

The scientist, because he cannot communicate to the layman, is necessarily asking the layman administrator and legislator, to act on very great and crucial matters involving the national security . . . on faith alone.

It is improper to deny that the scientist is asking that the administrator act on faith; the *scientist* may have reason, facts, understandings, and logic—but if it be true that the scientist cannot explain them understandably to the layman, as the scientist himself asserts, then the layman administrator *is in fact* not acting on reason, understanding, or logic. He's forced to act on faith in the scientist.

That that faith is not always one hundred per cent solid is perhaps somewhat more understandable when it is recognized that the scientist is blind on one side—and, it happens, on precisely the side the layman has his good eye!

The layman is blind on one side; he can't see on the side of deduction-from-basic-research. It's necessary for the scientist to clarify to him what the structure of deductive research is, and its important advantages, its needs and its rewards.

The difficulty is that it's somewhat like the sad plight individuals sometimes get into when the images as seen by the two eyes do not fuse. (This happens not infrequently under the affluence of sufficient incohol, but it also occurs as a more permanent disability.) Under those conditions, the two eyes each see well —each may have 20/20 vision—and each half of the brain is getting accurate reports from its eye. But one hemisphere sees only what lies to

the left, and ahead, while the other sees only right and ahead, and the two hemispheres are not communicating sufficiently to derive a mutually understandable picture of the external world.

A century ago, the great scientists were also great writers and communicators; the detailed technology of their work was, indeed, beyond the understanding of any but highly trained specialists—but the *meaning* of their work, the broad principles, were communicated. It would require a highly trained anatomist to understand the detailed evidence of Darwin's theory; the broad implications, however, were well communicated. The great thinkers of the last century were, and were expected to be, skilled communicators, authors who could express their ideas in a manner that interested intelligent men, not solely fellow-specialists.

That tradition is gone, somehow, somewhere. More and more the scientist says, "You wouldn't understand; you must accept my statement."

The scientist isn't alone in that; the other professions are doing the same. The economics advisor finds the scientist as bull-headedly ignorant as the scientist finds the economist.

But when the scientist seeks to support the great importance of basic research—which is truly a valid thing—and makes the egregious mistake of denying that there is another way to invention, he's headed for trouble.

Like most college physics students, I had to compute the angle of the force-vector involved when a kid going twelve miles an hour on a bicycle turns a corner on a twenty-foot radius of curvature. When I got fairly good at such problems, it took me about three minutes. At the time, doing them annoyed me because I regularly solved much more complex ones in split-second fashion when I was riding my bike.

Every human being—including administrators and legislators—has the day-to-day experience of the fact that most problems are solved without use of the deductive process.

To say that the deductive process is the *only* way to solve problems, the *only* way to achieve an invention, shows that the speaker is talking from a one-eyed viewpoint.

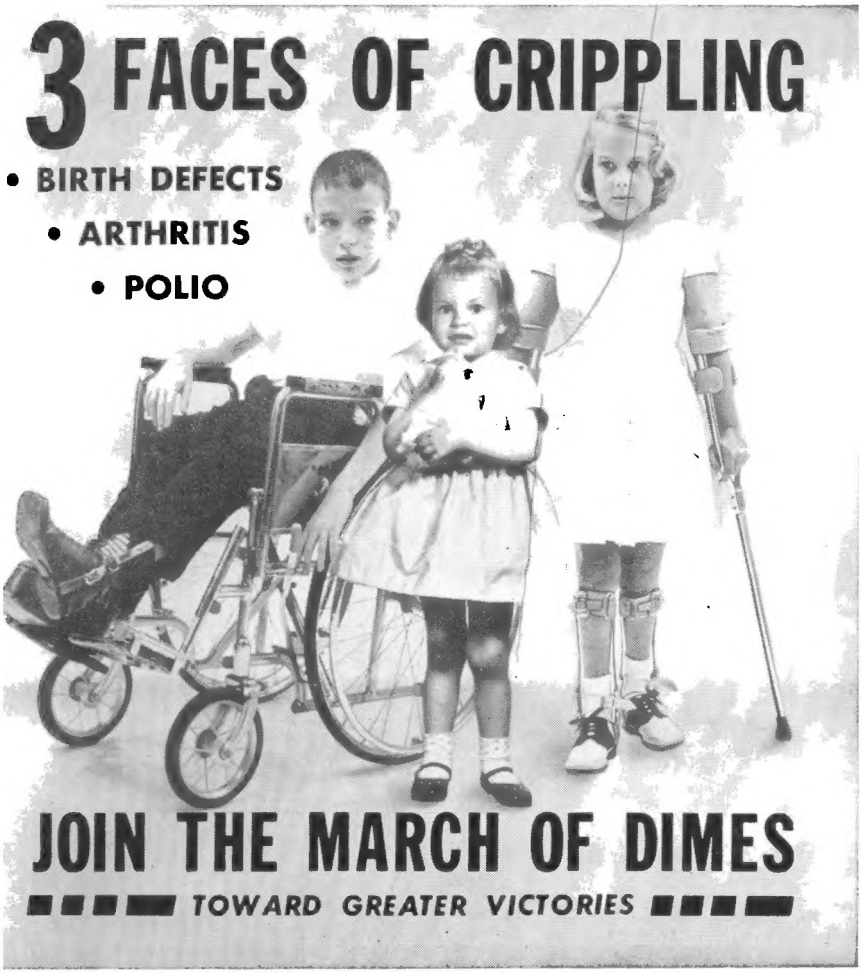
The deductive process is simply the only one which we can, at present, define.

But practically all the inventions we use were not derived at all; they did not stem from preceding discovery of key facts. Developmental research has been done on them—but they did not derive from basic research. What basic research preceded Man's first use of steel, concrete, the arch, scaffolding for constructing buildings, the suspension bridge, the wheel, or fire?

I think most of us recall Charles Lamb's "Essay on Roast Pig." Lamb may have been joking—but that process of invention is no joke.

THE EDITOR.

THE END



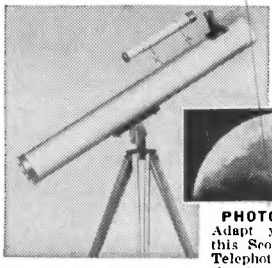
LOOKING TO YOU FOR HELP . . .

All three share one dream — to grow up able to move about and lead healthy normal lives. The March of Dimes can help them realize that dream if you give generously.

GET READY FOR THE SPACE and SCIENCE ERA! SEE SATELLITES, MOON ROCKETS CLOSE-UP

AMAZING OPTICAL BUYS

and OTHER SCIENTIFIC BARGAINS



PHOTOGRAPHERS: Adapt your camera to this Scope for excellent Telephoto shots and fascinating photos of moon!

. . . SEE THE STARS, MOON, PLANETS CLOSE UP

3" Astronomical Reflecting Telescope

Assembled and ready to use! 60- to 180-Power
An Unusual Buy—Famous Mt. Palomar Type

Assembled. Ready to use! You'll see the Rings of Saturn, the fascinating planet Mars, huge craters on the Moon, Star Clusters, Moons of Jupiter in detail, Galaxies! Equatorial mount with lock on both axes. Aluminized and overcoated 3" diameter high-speed f/10 mirror. Telescope comes equipped with a 60X eyepiece and a mounted Barlow Lens, giving you 60- to 180-power. An Optical Finder Telescope, always so essential is also included. Sturdy, hardwood portable tripod. FREE with Scope: Valuable STAR CHART plus 272-page "HANDBOOK OF HEAVENS" plus "HOW TO USE YOUR TELESCOPE" BOOK.

Stock No. 85,050-A.....$29.95 Postpaid

GIANT MAGNETS!

TERRIFIC BARGAINS!

War surplus — Alnico V type! Horseshoe shape. Tremendous lifting power, 5-lb. size. Dimensions: A—3¼"; B—2¾"; C—4 3/16"; D—1¼"; E—1¼"; F—2⅝". Strength is about 2,000 Gauss. Will lift over 125 lbs.

Stock No. 70,183-A.....5 lb. size.....$8.50 Ppd.

15¾-lb. size. Approximately 5,000 6,000 Gauss rating. Will lift over 250 lbs.

Stock No. 85,088-A.....15¾ lb. size.....$22.50
Shipping Wt. 22 lbs. F. O. B. Barrington, N. J.

D-STIX CONSTRUCTION KITS

For Science Fans, Hobbyists

Visualize your ideas. Crystallize your plans. Unique new D-STIX are ideal for "3-dimensional thinking." Colored wood sticks ⅛" thick and "easy-on" rubber joints approx. ⅝" diam. fit together fast—help you work out molecular structures, geometric figures, structural members, shapes, models of all kinds. Ideal for interesting children in developing shapes, structures. Durable kits. Money-back guarantee.

Stock No. 70,209-A (230 pcs).....$3.00 Ppd.
Stock No. 70,210-A (370 pcs).....$5.00 Ppd.
Stock No. 70,211-A (452 pcs).....$7.00 Ppd.

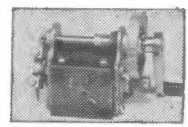
TERRIFIC BUY! AMERICAN MADE!

OPAQUE PROJECTOR

Projects illustrations up to 3" x 3½" and enlarges them to 4 ft. wide. Ideal for sales meetings, designers, artists, schools, clubs, scout meetings, parties, "show-and-tell," etc. No film or negatives needed. Projects charts, diagrams, pictures, photos, lettering in full color or black-and-white. Operates on 115 volt, A. C. current, 6-ft. extension cord and plug included. Operates on 60-watt bulb, not included. Approved by Underwriters' Laboratories, Inc. Size 12" x 8" x 4½" wide. Wt. 1 lb., 2 oz. Plastic case with built-in handle.

Stock No. 70,199-A.....$7.95 Postpaid

WAR SURPLUS ELECTRIC GENERATOR



Brand-new Signal Corps Generator for endless experiments, electrical uses, demonstrations. Generates up to 90 volts by turning crank. Use in high impedance relays. Ring bells. Or charge ground and bring up night crawlers for fishing bait. Has 2 Alnico Magnets. Weight 2 lbs. Cost Govt. $15.00.

Stock No. 50,225-A.....$3.95 Postpaid

CLOSE OUT!

MECHANICAL DRAWING SET

Regular Price $18.00. Our Price Only $8.00 Postpaid. American manufacturer couldn't compete with foreign imports thus you get a terrific bargain, even far below import prices. 10 handsome pieces in velvet-lined case. Nickel plated brass—precision American-made. We guarantee you'll be satisfied or money refunded.

Stock No. 50,200-A.....$8.00 Postpaid

BARGAIN-PRICED STETHOSCOPES

Ideal for home craftsmen, hobbyists, schools, children. Listen to running machinery. Check on hard-to-hear motor noises, leakage of gas, air or fluid. Pick up heart beats of animals, insect noises, other "unhearable" sounds.

Stock No. 50,223-A.....$2.95 Postpaid
Stock No. 50,270-A..DeLuxe Model..$5.95 Ppd.

Get FREE CATALOG "A"

128 PAGES — OVER 1000 BARGAINS

America's No. 1 source of supply for science experimenters, hobbyists. The World's largest variety of Optical Items. Bargains galore. . . . War surplus—Imported—Domestic! Microscopes. Telescopes. Satellite Telescopes. Infrared sniperscopes and parts. Prisms. Lenses, Reticles, Mirrors and dozens of other hard-to-get Optical Items.

WRITE FOR FREE CATALOG "A"

ORDER BY STOCK NUMBER . SEND CHECK OR MONEY ORDER . SATISFACTION GUARANTEED!

EDMUND SCIENTIFIC CO., BARRINGTON, N. J.